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THE

SANITARY CONDITION OF BOSTON.

THE

REPORT OF A MEDICAL COMMISSION,

CONSISTING OF

CHAS. E. BUCKINGHAM, M.D., CALVIN ELLIS, M.D., RICHARD M. HODGES, M.D., SAMUEL A. GREEN, M.D., AND THOMAS B. CURTIS, M.D.,

APPOINTED BY THE

BOARD OF HEALTH OF THE CITY OF BOSTON,

TO

INVESTIGATE THE SANITARY CONDITION OF THE CITY.

BOSTON:
ROCKWELL AND CHURCHILL, CITY PRINTERS,
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OFFICE OF THE BOARD OF HEALTH,
BOSTON, October 15, 1874.

SIR, — Owing to a general impression that the rate of mortality in Boston is large, His Honor the Mayor has communicated to us a desire to have the subject investigated.

To this end the Board of Health respectfully ask you to serve on a committee, to examine the question with reference to its causes and prevention, and report to them at your earliest convenience.

It is their earnest hope that it will lie within your power to act on this committee, which is to consist of DR. CHARLES E. BUCKINGHAM, DR. CALVIN ELLIS, DR. RICHARD M. HODGES, DR. SAMUEL A. GREEN, and DR. THOMAS B. CURTIS.

Very respectfully,

A. W. BOARDMAN,
Chairman.

Boston, Nov. 1st, 1875.

To the Board of Health of the City of Boston: —

Gentlemen, — In presenting the accompanying document for your examination, we feel that the credit of preparing a paper of so great importance should be fully given to him to whom the credit is due. We therefore, without his knowledge, and with great pleasure, say that Dr. Thomas B. Curtis, the Secretary of our Committee, is entitled to be known not only as having laid out the work, but as having chiefly performed it. The most that we can claim is that we have carefully reviewed and approved it.

Hoping that this note may be printed with the report,

We are,

Respectfully yours,

CHARLES E. BUCKINGHAM,
CALVIN ELLIS,
RICHARD M. HODGES,
SAMUEL A. GREEN.

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REPORT.

INTRODUCTORY REMARKS.

The death-rate of the City of Boston has recently been excessively high. From 23.5 deaths per 1,000 living inhabitants, which was the rate for the year 1871, the mortality rose in 1872 to 30.4, and remained in 1873 as high as 28.5. Turning, for purposes of comparison, to the two greatest cities of Europe, we find that the death-rate of London in 1872 was 21.4, while that of Paris was 21.1. So great an increase of the mortality of our city could not fail to cause some alarm in the public, and to excite the attention of those who have charge of our sanitary interests. It was therefore deemed advisable that the mortality of the City of Boston be subjected to a thorough investigation, in order that the causes of the excessive mortality might, as far as possible, be discovered, and that preventive measures of sanitation might be suggested. It was thought that such investigations could be fruitfully carried out only by members of the medical profession, and the Board of Health consequently appointed a committee of five physicians, consisting of Dr. Charles E. Buckingham (Chairman), Dr. Calvin Ellis, Dr. Richard M. Hodges, Dr. Samuel A. Green, and Dr. Thomas B. Curtis (Secretary).

The following report is the result of our investigations: —

Before entering upon our subject, a few introductory remarks upon the nature and the magnitude of the task which is set before us may not be out of place, not indeed for the purpose of magnifying the undertaking, but rather in

extenuation of unavoidable shortcomings and delays in its execution.

We trust that we may be allowed, in the first place, to call the attention of our readers to the great importance of such investigations as are now entrusted to the committee appointed by the Board of Health. For the first time since registration has existed in Boston, a body of physicians is officially called upon to turn to account the vast amount of statistical material collected and published year after year by the City Registrar, in order that the facts therein contained may receive their proper interpretation, that their significance may be elucidated, and that the sanitary lesson which they contain may be shown forth for the practical benefit of the community. This is indeed the consummation of the very end in view of which the registration of deaths takes place; one of the chief objects of mortality returns and reports is the collection and preparation of materials ultimately to be handed over to those who are presumed to be competent, by virtue of their professional education, to deal with questions of public hygiene and sanitation. The statistics accumulated each year by the Registrar and his clerks are destined, in the natural course of events, to serve as a basis for the sanitary operations of the Board of Health; for the accomplishment of this purpose it is indispensable that they should first be submitted to the investigations of the hygienist. Unless so utilized, these statistics can be but a dead letter, and must remain practically valueless. They contain little more than the bald statement of disease and death. From this statement to recognize the causes of excessive and undue mortality, and the degree of its preventability, and to deduce suitable prophylactic measures, is a task which physicians only can be considered competent to undertake.[1]

[1] See a paper on the "Registration of Mortality in Boston," by F. W. Draper, M. D. Second Annual Report of the Board of Health of the City of Boston, p. 73.

The importance of our task is sufficiently manifest; its vastness is also at once apparent when we reflect that no less a problem is set before us than to estimate the practical value and efficacy of all the varied resources of public hygiene, as applied and carried out in a city of over 350,000 inhabitants. A lifetime would not suffice for investigations at once of such wide comprehensiveness and of such infinite detail, did we not at the outset recognize the necessity of limiting our undertaking, with a view to its earlier usefulness. Therefore, when we shall have ascertained, by comparison of the past and present sanitary history of Boston with that of other communities of the old and of the new world, to what extent we have reason to feel dissatisfied with our present sanitary condition, we shall make it our task rather to point out in what direction danger lies, and where reform appears to be needed, than to prescribe in detail all the measures which may usefully be adopted throughout the community.

The exceptionally *high death-rate* of this city in the years 1872 and 1873 was, as we have said, the occasion and incentive of our investigations. Before instituting an extended examination into statistics, of which *death-rates* are an important part, it may be well, in consideration of recent dissensions on this subject, to bestow some attention to the question of the significance and value of general death-rates.

It had, until lately, been generally admitted, without question, that in the proportion of deaths to population we had a satisfactory approximative measure of the sanitary condition of any community. "General death-rates" which expressed that proportion by stating the number of deaths per annum to one thousand living inhabitants were supposed to represent, in a convenient and ready way, the degree of prevalence of fatal disease in any given population or group of inhabitants; and for the purpose of comparing the san-

itary conditions of different populations, or of the same populations at different periods, such death-rates have long been in general use in all civilized countries.

Recently, however,[1] their value as indices of public health has been contested, on the plea that such *general* death-rates were greatly influenced by conditions independent of sanitation. The variations of the birth-rate constitute the most important of these alleged perturbing influences, which react upon the death-rate chiefly by modifying the *age-distribution* of the populations compared; migration and the varying proportions of the sexes were also asserted to be causes of perturbation; the birth-rate, it was said, is "the controlling element" of the death-rate, and, as general death-rates do not allow for this chief disturbing influence, nor for the others above mentioned, it was asserted that they were "entirely fallacious" and "useless as exponents of facts."

In answer to these allegations, it has been conclusively shown that the extreme limits of disturbance produced in any population by variations of age-distribution does not exceed 2 per 1,000 in the rate of mortality; and then, except in a few cases, the limit as affecting town populations is only 1 per 1,000. As for the perturbation caused by variations in the proportion of the sexes, it is shown that it cannot exceed 0.2 per 1,000. Migration exerts little or no influence upon the general death-rate. The final conclusion arrived at, after a full consideration of the question, is that "not one of these disturbing influences, or the combined results of them all, would so affect a death-rate calculated upon the national system as to warrant its being disregarded as a test of sanitary condition."[2]

---

[1] See Dr. Letheby's Presidential Address at opening of session of 1874 of Society of Officers of Health. Also, Lancet, Oct. 31, 1874.

[2] See paper by N. A. Humphreys, on the value of death-rates as a test of sanitary condition, read before the Statistical Society of London, Dec., 1874; in Practitioner, Feb., 1875, p. 143.

These statements, based as they are upon a mathematical demonstration and a thoroughly convincing argumentation, are, to our mind, conclusive; furthermore, they completely concur with the results of a similar investigation instituted by ourselves, with a view to determining the influence exerted upon the death-rate of Boston in 1865, by changes in the age-distribution of our population resulting from the war. If we correct the anomalous age-distribution existing in 1865, so as to reconstitute our population upon its normal basis, the *hypothetical* general death-rate which can then be deduced is 24.82, showing that the diminution of the *real* death-rate attributable to the loss of infants and of children under 5, and therefore independent of sanitary conditions, amounted only to 1.20. (See Appendix I.)

We therefore hold that general death-rates are governed in their rise and fall almost exclusively by sanitary conditions, and that they afford an approximative, and, on the whole, a very satisfactory measure of the health and sanitary condition of the populations which they characterize.

The same cannot be said for another numerical expression which is often supposed to have some value as an exponent of healthfulness, or of sanitary condition. The "*average age of decedents*," or "*mean age at death*" is obtained by summing up the ages at which people die, and dividing the number of years by the number of deaths; the number resulting is supposed to represent the average longevity of the population, and, by erroneous inference, the degree of health prevailing in the community.

The following extract from the fifth report of the Registrar-General of England (p. 41) shows how little reliance can be placed upon such data: "If the reasoning upon 'the average age at death' be employed to determine the relative salubrity of towns and professions as well as of different classes of the community, the nature of the results may be readily divined.

The mean age at death is 29 years in England, 29 years in the metropolis, 34 years in Surrey; the true mean durations* of life being nearly 41, 37, and 45 years; so that the errors by this method amount to 12 years, 8 years and 11 years! The rate of increase, the duration of the increase of population, the emigration, the relative numbers of children and adults, the mean age of the living, — upon all of which the 'mean age at death' depends, — differ in town and country, in agricultural and manufacturing districts, to an extent which renders any application of the method to the construction of local

* The true "mean duration of life," technically called the "expectation of life" (*vie moyenne* of the French), represents the average number of years that children born in the specified community live, and is very different from the "average age at death"; the "expectation of life" constitutes a true statement of longevity, and is of value in many ways, for applications to sanitary science, as well as to business transactions, such as life insurance, pensions, etc. It is obtained from the Life Table, by adding together the number of years which the whole tabulated population live, and dividing the resulting total "years of life" by the number living at the year of age for which the expectation of life is desired. (See 5th Report of Registrar General of England, p. 24.) The terms "average age at death," and "mean duration of life" (also called technically "expectation of life"), are sometimes used erroneously as synonyms. In a paper by a distinguished statist we find the following instance of this confusion of terms, leading to a comparison of entirely dissimilar statistical facts: "In the census of 1870 General Walker estimates the mean average duration of life in the United States to be 39¼ years. In England the expectation of life generally is 41 years; for males 40, for females 42. Inhabitants of this country can never hope to equal England in longevity, and these figures are consequently too high, for the average age at death in Michigan in 1870 was 23.50 years; in Rhode Island, 1860, 29.64; males 28.51; females 30.70." (From a paper on "statistics relating to the births, deaths, etc., of the city of Philadelphia," by T. Stockton-Hough, M.D. in the Penn. Monthly, 1873, p. 510.) Now it is true that in England the "expectation of life" is at birth 41 years, but the "average age at death" is but 29 years, which figure, as Dr. Stockton-Hough himself shows, was exceeded in Rhode Island in 1860; so that this statement that we in this country cannot hope to "equal England in longevity," though probably correct, is not borne out by the figures which he adduces. We probably do not live quite so long as the English, but the difference is slight, and by no means so much to our disadvantage as that which the author whom we quote obtains by comparing our "average age at death" with the English "expectation of life."

life tables, or to the calculation of the relative duration of life, difficult and doubtful, if the proper corrections be made; absurd and misleading, if the 'mean age at death' be taken to represent the expectation of life.

"The numbers following different professions fluctuate more than the general population; the relative proportion of young and aged persons varies from year to year; certain professions, stations and ranks are only attained by persons advanced in years; and some occupations are only followed in youth; hence it requires no great amount of sagacity to perceive that 'the mean age at death,' or the age at which the greatest number of deaths occurs, cannot be depended upon in investigating the influence of occupation, rank and profession upon health and longevity.

"If it were found upon an inquiry into the health of the officers of the army on full pay, that the 'mean age at death' of 'cornets, ensigns and second lieutenants' was 22 years; of 'lieutenants,' 29 years; of 'captains,' 37 years; of 'majors,' 44 years; of 'lieutenant-colonels,' 48 years; of general officers, ages still further advanced; and that the ages of curates, rectors and bishops; of barristers of seven years' standing, leading counsel, and venerable judges, differed to an equal or greater extent, a strong case may no doubt be made out on behalf of those young, but early dying cornets, curates, and juvenile barristers whose 'mean age at death' was under 30. It would be almost necessary to make them generals, bishops and judges for the sake of their health. . . . . ? It has been somewhere stated that the 'mean age at death' of dressmakers is exceedingly low, and this has been adduced as a proof of the destructive effects of their calling. If the inquiries had been extended to boarding-schools, or to the boys at Christ's Hospital, the 'mean age at death' would have been found still lower. Mr. Grainger states, in his interesting report, that the majority of dressmakers are be-

tween the age of 16 and 26; and it is understood that if they die after they marry they are not often designated by that title in the register."

In the annual report of our City Registrar for 1873, (p. 15) is the following table, giving the average age of decedents of different parentages, native and foreign:—

	Years.	Months.		Years.	Months.
Native, males	26	11	B. A. Provinces, males	11	4
" females	31	7	" " females	13	9
Irish, males	23	6	German, males	21	2
" females	19	3	" females	18	8
English, males	25	..	Other foreign, males	21	1
" females	24	6	" " females	13	5
Scotch, males	29	9	Colored, males	22	4
" females	25	2	" females	27	11

The City Registrar calls our attention, without comment or explanation, to the fact "that the average age of the Scotch male decedents exceeds that of any other class." Are we to infer that the Scotch and their offspring among us are more healthy and live longer lives than inhabitants of native, or of Irish, German, or British-American parentage? By no means. For, if we compare the *fecundity* of these different groups of our foreign-born population, we find, by the Census and Registration Report of 1870, that, among 100 living inhabitants of Boston born in Scotland, the yearly births of unmixed Scotch parentage were 1.66, whereas to every 100 Irish-born inhabitants there were 4.02 yearly births of unmixed Irish parentage, and among the British Americans the births were 2.6. It follows, from the lowness of their birth-rate, that our Scotch population comprises a very large

proportion of adults, with comparatively few infants and children; their average age at death is high because their birth-rate is low. Among the more fecund Irish, on the other hand, the birth-rate is higher than among any other portion of our population; infants and children are correspondingly numerous, and, as they die in large numbers, their early deaths tell strongly on the average age of Irish decedents. We see, moreover, that the average age at death among our British-American population is extraordinarily low, namely (for both sexes), 12 years and 7 months. Are we to conclude that these constitute the most unhealthy part of our population? If so, their deaths must be very numerous. But, by the returns of the last census year (1870), we find that, to 100 inhabitants born in British America, the decedents of corresponding parentage were but 1.66, whereas, among the long-lived Scotch, the deaths per 100 were 1.95. Both of these facts observable among our British-American population, namely, the small proportion of deaths (pointing to a low death-rate) and the low average age of their decedents, can be due to only one cause: this group of our exotic population must be composed in great part of youthful individuals, children, adolescents, and young adults, at ages where mortality is low, and where the few deaths occur mainly at early ages.

These few examples are more than sufficient to show that the "average age at death" bears no regular relation to the true mean duration of life, or to sanitary condition, and that this product of statistics is absolutely valueless for sanitary investigations.

The most satisfactory measure of the duration of life in any community is afforded by a *life table*. From it we can learn, for any specified age and for either sex, the annual rate of mortality, the probable duration of life, the "expectation of life," the chances of living a year or any number of years, and, from a given number born, or living at any

age, we can find the number living at any future age. Such a table is most valuable both for sanitary uses and for pecuniary transactions based upon life contingencies.

A series of mortality rates, obtained by dividing the deaths by the living at different ages, is also an unimpeachable test of the health and sanitary condition of a population. "Special death-rates," in which the causes of death, as well as the ages, are specified, are also very valuable. The ratio of the total annual deaths to the total population, expressed as a general death-rate, constitutes the next best test that can be employed. If the populations compared are similar in age-distribution, their relative mortality can be correctly estimated by this method.

Such is the order as regards scientific value in which the various methods of appreciating life contingencies are placed by statists.*

The question now arises, to what extent are these different methods applicable for the purpose of the present inquiry into the sanitary condition of our city? The answer must evidently depend upon the statistical data necessary for such investigations, and the supply thereof that may at present be available. A short review of the statistical material now at hand relating to the City of Boston may here be useful, to show the limits within which our investigations have by necessity been confined, and to enforce certain suggestions relating to the preparation of statistics for future use.

The construction of a life table founded upon the lives and deaths of Boston is out of the question at present; for, had we the ability, the requisite data are wanting to us.† We can only express a hope that, before long, perhaps in connection with the next Massachusetts census, this want

* See 5th Report of Registrar-General of England, p. 43.

† It has been said (Lancet, Oct. 31, 1874) that one could probably count upon his fingers the number of men in England competent to construct a life table.

may be supplied, and that some public-spirited individual, sufficiently familiar with mathematical operations, may be induced to provide the community with a properly constructed life table. The Ninth United States Census, of 1870, contains (Vol. II., p. xi.) a life table for the United States, calculated from the lives and deaths of the entire country, upon the assumption of a *deficiency of forty-one per cent.* of the full number of deaths that must have taken place. Although a table so constructed must be comparatively unreliable, we shall use the rates of mortality at different ages therein contained as terms of comparison with analogous rates derived from the mortality returns of this city.

A series of *death-rates* at selected ages is the most valuable expression of the mortality of our population which we have been able to obtain. Unfortunately, however, we have only been able to calculate such special death-rates for the two State census years 1855 and 1865, the data required for such tables being, 1st, the number living at the different selected ages; 2d, the yearly deaths at these ages. Our State censuses alone give the population, at different ages, the last United States census (1870) omitting to do so; on the other hand, our City Registrar issued no yearly report in 1860, so that for that State-census year the deaths at different ages are wanting. We have, therefore, been obliged to content ourselves with calculating the annual death-rates per 1,000 living at each specified age for the years 1855 and 1865, and from these rates we have obtained a series of mean death-rates, which are tabulated with the rates for those two years, and are more likely to approximate the real rates than those obtained for either year separately. (See Table on page 46.) These mean death-rates at selected ages are very valuable to us, inasmuch as we can compare them with similar rates contained in the life tables of the United States and of England, as well as of other countries, and also with the rates at different ages prevalent in certain English

populations, both urban and rural (London, Liverpool, and Surrey, 1841).

Special death-rates by various diseases, such as phthisis, or small-pox, or by groups of associated diseases, such as diarrhœal diseases or zymotics in general, such rates expressing the numbers dying of the selected diseases out of one thousand living inhabitants, in the twelve months, or every year, are obtainable for any year, from the returns of our City Registrar, provided the population be known; but this datum, which is indispensable if we wish to determine any rate, whether of births or deaths, general or special, is only known in a satisfactory way for the census years. The special death-rates by specified diseases are extremely useful, as we can by them determine the amount of mortality due to each disease, and as they furnish terms of comparison between different communities; by means of these rates, the part played by epidemic and endemic diseases can be accurately determined, and the necessity for particular measures of prevention can be recognized, with regard to diseases whose causation is understood, and which are amenable to prophylaxis.

Another kind of special death-rate, or, more correctly speaking, another kind of numerical expression representing sanitary condition from a special standpoint, comprises those ratios of deaths to population in which the *nativities* or the *parentages* of decedents are distinguished. Our country contains a population of the most heterogeneous character, of which a part is native to the soil, and born of parents themselves native; while another part is native, but born of foreign parents, and still another part is foreign-born. These elements of native and foreign origin, and the various foreign stocks, compared together from the point of view of sanitary science, are found to present great and startling differences; as a rule, the foreign populations, whether foreign-born or native, of foreign parentage, offer much higher

death-rates than those which prevail among the purely native population; and among the foreigners themselves the rates of mortality and the prevailing types of fatal disease differ greatly. Thus, taking the two chief foreign elements which most largely contribute to our foreign population, the Germans and the Irish, we find that the deaths are much more numerous among the latter than among the former; if the requisite data as regards population were at hand, so as to allow of their death-rates being calculated, we should find that the death-rate of the Irish was much higher than that of the Germans: also that they are very much more liable to phthisis than either the Germans or the natives.

Now, the proportion of foreign population varies very much throughout the country, and the composition of this foreign element is also variable; the Germans predominate in one community, and the Irish in another, to say nothing of the other nationalities which are less important, because less numerous; and, as these two predominating foreign elements differ widely in general liability to death, and in susceptibility to various specified diseases, as well as in fecundity, their national characteristics in this respect tell unequally and differently upon the sanitary statistics of the communities on which they are grafted.

This want of homogeneity makes the population of our country very interesting to the sanitarian and to the statist, although, at the same time, their investigations are thereby rendered much more complicated and difficult than when applied to a population of comparatively uniform and unmixed origin. The assemblage in our country of representatives of many of the leading races of mankind allows us to institute a study of the *comparative mortality* of the various foreign races, which are here gathered together and subjected in common to the influence of similar external conditions, as if for the express purpose of scientific experimentation. By comparing the deaths, by all and by selected

diseases, occurring among given numbers of the various nationalities assembled together in our country, we might, to a certain extent, determine for each race its amount of innate healthfulness, its power of resistance to disease, and its degree of adaptability to our climate and institutions. It would be very interesting, and perhaps useful to us, in the interest of future generations, to determine the value of the foreign stock which is yearly added to our population, in order that we might, as far as should be in our power, favor the immigration of the more robust races, and discourage those who are found to be less capable of adapting themselves to our climate from attempting a fruitless struggle for life on this continent.

Such a study can at present be pursued only under great difficulties, for lack of the necessary statistical data. To calculate death-rates of any kind, two sets of data are indispensable, namely, the numbers of the living, and the numbers of deaths occurring among them; such data, correctly distinguishing the native and foreign populations of all ages, are not obtainable under our present system of registration, and with the distribution of population now used in making up our census. When it is remembered that the whole civilized population of this continent is primitively, and comparatively recently, of exotic origin, and that what we call our native population has sprung within one or at most a few generations from immigrant foreigners, we can recognize, on reflection, how closely interwoven the native and foreign elements must be, and how difficult it is to separate them for the purposes of a statistical inquiry. The United States census, which is taken every ten years, gives us, for each State and Territory, and for the fifty largest cities, the numbers of native-born, and of foreign-born of each nativity. But populations so divided are quite unsuitable for sanitary statistics, inasmuch as they are wholly anomalous as regards *age-distribution*, the children, born in

this country of foreign parents, being counted among the natives; consequently the *native population*, so called, is exaggerated in numbers, and contains very much more than its appropriate quota of *children*, while the foreign populations, on the other hand, are understated, and are composed in great part of *adults*. Of course, with populations so constituted, it is impossible correctly to calculate *rates* of any kind, whether birth-rates or death-rates.*

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* In a paper by one of our most distinguished statists, we find this statement: "In Massachusetts, as before stated, one-half of the births are recruited from less than one-fourth of the population (foreign), or foreigners are more than three times as prolific as the natives." Here the mistake has been made of comparing together the native and foreign populations, as regards fecundity, without taking into consideration the anomalous age-distribution due to a defective mode of numeration. Of course a population composed almost exclusively of adults, like our foreign population, yields a larger proportion of births than a population composed largely of infants and children, as is the case with our (so called) *native* population, which comprehends not only the children of native parentage, but the very numerous children of foreign parentage besides. The inference that foreigners are more than three times as prolific as the natives is incorrect. (Statistics relating to births, deaths, etc., by T. Stockton-Hough, Penn. Monthly, vol. 4, p. 600.)

The same mistake is committed in the City Registrar's Report for 1872 (p. 5), when the following calculations are made: "Estimating the Irish population at 58,000, the births of that parentage are in the ratio of one birth in each 18.10 of the same population. At the same time, the children born of American parents are in the ratio of one birth in 74.92 of the estimated population of 174,000." The Irish would thus appear to be more than four times as prolific as the natives; but this result, as well as the calculations from which it is obtained, is wholly incorrect, for the reasons given above.

Still another instance of the same kind of error is found in the City Registrar's Report for 1873 (p. 7). Here we are told that among the native population, still-births are in the ratio of 1 to 893 living, while the ratio among the Irish is 1 in 281.68; among the Germans 1 in 215.53; among the English 1 in 234. According to these figures, still-births would appear to be over three times more frequent among foreigners than among natives.

Again, in the report for 1874 (p. 6), we are told that "the children whose parents were born in Ireland exhibit a ratio of one birth to 20.05 of the Irish population. In strong contrast to this is the fact, that the births of children of native parentage show only one birth to 73.24 of the native population."

These instances suffice to show how great is the error involved in this

But this division of population yields data not altogether useless for the sanitary statist; rates cannot be calculated, nor can the native population correctly be compared at all with the foreign, on account of the displacement of the native offspring of foreign parentage, but the events occurring among the various foreign populations taken by themselves, their yearly births, and their deaths by all or selected diseases, can fairly be compared, inasmuch as all the foreign populations are similarly affected in common by the mode of numeration used in the census. Thus, knowing the yearly number of deaths occurring in a given number of Germans, and of Irish, we can ascertain to what extent their death-rates proper would differ, could they be computed; so, also, knowing the relative frequency of deaths by phthisis among the various foreign populations, we can estimate the degree of susceptibility to this disease characteristic of each race.

Investigations of this nature are much limited in consequence of the inadequacy of mortality returns properly distinguishing the *nativities* and *parentages* of decedents by specified diseases and at selected ages, and also in consequence of the lack of census returns specifying the *parentages* of the native-born population. The registration reports of our city contain each year a table showing the *birthplaces* of decedents by all diseases, at all ages. Another table gives the *parentage* of such decedents. A third shows the number of decedents at various ages under fifteen years of age, divided into decedents of native and of foreign parentage. A fourth gives the *birthplaces* of decedents by phthisis, this being the only disease in connection with which the nativities of decedents are specified. Such is the extent of all the

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vicious mode of computing ratios of births and deaths to population, and how commonly the mistake of so proceeding is made, even by those who are accustomed to dealing with vital statistics.

information with which we are supplied in relation to the *nationality* of decedents in Boston. On the other hand, as regards population, the U. S. census gives us, in one table, the number of foreign-born of each nativity living in each State, in each county, and in the fifty largest cities; while another table shows the population of *native* and *foreign* (unspecified) parentage by States and counties. From these combined data very valuable results are obtainable, which will be given in a separate chapter (see Chapter II.), showing the part played by each of the ingredients of our population in the production of our general death-rate, and the characteristic manner, as well as the degree, in which each nationality contributes to our sanitary condition. The existing data do not, unfortunately, admit of our ascertaining the nativities or the parentage of decedents by any specified disease except phthisis. Nor, on the other hand, turning to the question of mortality at selected ages, can we form more than an approximative idea of the comparative duration of life among the native and the various foreign elements of our population. Yet it would evidently be extremely interesting and useful to us to know exactly what proportions of our excessive *infant mortality* belong respectively to the natives and to the various foreigners living in our community. A great desideratum appears to us to be the preparation of data, having reference both to population and to mortality, to be published in our census reports and in our city registration reports, which should allow of our computing special death-rates by specified diseases, and at selected ages, distinguishing the birthplaces and the special parentages of decedents. The collection and publication of such data would doubtless involve considerable labor and cost, but the results obtainable seem to us of a nature to repay the outlay; this view seems to us to be justified by the imperfect results which the existing inadequate data have allowed us to obtain.

Certain circumstances peculiar to the present time and place have enhanced the difficulties encountered in the course of the present attempt to study the sanitary history and condition of Boston. In the first place, we know that the registration of this city was very incomplete,[1] and consequently unreliable, up to the year 1860, when the Amended Registry law came into operation. Then, no registration report was published in 1860 and in 1861, so that we entirely lose the benefit of the State census which was taken in 1860, and which gives the population at selected ages. The last census which gives us the ages of the population of our city is that of 1865, and the last census of any kind is the Ninth United States census of 1870. This census gives the ages of the population by counties, but the ages are divided in such a way as to be unavailable for sanitary statistics. At the time when it was taken, however, a special enumeration was made in Boston by the officers of the census, at the request of the State Board of Health; and we thereby know for the year 1870 the population of Boston and of each of twenty-four *health districts* at ages under one year, from one to five, and over five. The data obtained by means of this enumeration of our population have yielded very valuable results in the hands of Dr. F. W. Draper, who has tabulated the mortality rates by various diseases at the ages above specified in each health district.[2]

The present time, being remote from the periodical

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[1] See the City Registrar's Report for 1859, p. 20.

In the seventeenth registration report of Massachusetts (page 39) the following statement is made: "The records for the year 1855 were very carefully examined by Mr. E. B. Elliott for another purpose, as stated in our last report, and it was estimated that in that year not far from sixteen per cent. of the deaths which occurred in the State escaped registration; and it is presumed that the records of some years would exhibit still greater deficiencies."

[2] See Second Annual Report of the State Board of Health of Massachusetts, 1871. Article on "Mortality of Boston in 1870," p. 350.

enumeration of our population which takes place every five years, is most unfavorable for statistical purposes, as we are obliged to content ourselves with estimated valuations of the population. Then, again, it must be remembered that the war with the South caused social perturbations, which, reacting upon our sanitary condition, affected our birth and death rates, as well as the age-distribution of the population very considerably, and that the effects of these perturbations have only recently passed away, if indeed they do not still remain appreciable.*

Finally, and the source of difficulty to which we now call attention is not peculiar to Boston, but attaches to sanitary statistics throughout the population of our country, the *unhomogeneity* of our population as regards *race*, and the very unequal susceptibility to disease characteristic of its various component elements, greatly enhances the difficulty of investigations into the causes of disease; in many cases, indeed, it even makes them impossible. For instance, let us suppose that we wished to find out in what ward of the city, or in what part of the State, or of the country at large, phthisis or cholera infantum were most rife, with a view to determining the physical conditions of soil or of climate upon which these diseases depend for their development; we know that they prevail far more extensively among the foreign population than among the native; consequently, we shall always find that the localities most visited by these diseases are those which are exclusively, or in great part, inhabited by the foreign population. The morbific tendencies of the foreigners are so marked as to outweigh, and to a great extent *mask* the influence of the conditions of soil, of exposure, of drainage, or of climate, to which we might look for the causes of endemic disease. Where the

*In 1855, children under five were 12.5 per cent. of the aggregate population; in 1865, their percentage was 10.3; in 1870, it was 10.5.

foreigners are, there, as a general rule, are phthisis, infantile mortality, as well as ill-health, and excessive mortality generally. Thus the study of the influence of hygienic conditions as causes of disease is rendered very obscure and difficult, the intrinsic morbid proclivities of the subject transcending by their potency the influence of the surrounding hygienic agents, which are such important factors of sanitary condition.

As an illustration of the difficulties which may arise from this source in the course of attempts to elucidate the causes of disease, and as an instance of ambiguous interpretation of facts bearing upon a complex question of etiology, we will cite the following, as a case in point. For a number of years back there has been a gradual diminution of the death-rate from consumption in Boston, as well as throughout the State of Massachusetts. Thus, in 1855, the rate was 4.58 in 1,000, 50.7 per cent. of the decedents by this disease being Irish; while in 1870, the rate had fallen to 3.95, the percentage of Irish consumptives being 40.2. Now, we find that the proportion of Irish population has also been steadily diminishing *pari passu* with the diminution of phthisis; for, while, in 1855, our percentage of Irish population was 28.8, in 1870 it was but 22.7. What is the cause of the diminution of consumption among us? Do these two facts, whose coincidence we have just pointed out, namely, the diminution of the Irish element of our population and our diminished liability to consumption, stand in any mutual causal relationship? Or must we look to some climatic change as the probable cause of the improvement as regards phthisis? The following quotation, emanating from high authority, reproduces the latter interpretation of the facts: "The table which follows* exhibits the fact that there is a gradual im-

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*Table showing mortality from consumption in Massachusetts during 21 years.

provement as regards the destructiveness of consumption, when a long series of years is included in the comparison. In previous reports greater intelligence on the part of the people in the matter of self-preservation, and on the part of the physicians as regards the management of the disease, has been assigned as an explanation of this progressive improvement. To this we would add another condition, which appears to deserve consideration. In an instructive essay recently read before the New Hampshire Medical Society, Dr. J. H. Ham presented a careful analysis of the meteorological changes as observed in the United States during a long course of years. He concludes that our climate has undergone a change in its humidity as the result of man's agency in felling the forests, in agriculture, in the building of canals and railroads, and in more general attention to drainage; and that, as a consequence of this increased dryness of the atmosphere, diseases of the respiratory organs are less prevalent than formerly."[1]

We will not, for the present, attempt to decide whether the credit of this sanitary improvement belongs properly to beneficial climatic changes, or to a diminution of that element of our population which is characterized by a predisposition to phthisis. We now only wish to show by example how difficult it may be to discriminate between the influences of external hygienic conditions, on the one hand, and those of morbid tendencies inherent in certain nationalities, on the other; and to point out how necessary it is, in investigating the complex causes of disease, to take into consideration both of these etiological factors.

For the purpose of introducing some method into the arrangement of the mass of facts which must be brought before our readers, we have subdivided the subject-matter of our inquiry into four questions, which constitute the pro-

[1] Thirty-second Registration Report, Mass., 1873, p. 77.

gramme of our investigations into the mortality of the City of Boston. Our report consequently contains four chapters, in each of which we shall attempt to answer one of the following questions, which we have propounded to ourselves as part of our inquiry: —

I. Is the present mortality of the City of Boston excessive; and, if so, to what extent?

II. In what portion of our community, as regards age and nationality, does the excess of mortality exist?

III. What is the nature, and what are the causes, of the diseases which occasion our excess of death? To what extent, and by what means, are these diseases preventable?

IV. What measures of sanitation are recommended?

CHAPTER I.

Is the present death-rate of the City of Boston excessive, and, if so, to what extent?

In attempting to decide whether the death-rate of this city is or is not *excessive*, our first thought is to inquire whether it is now greater than in former times, and whether it is greater than that of other cities whose sanitary condition is thought satisfactory. We are therefore led first to compare together our past and our present sanitary condition, as evidenced by our records of mortality; having done which, we shall compare our own mean death-rate with the rates prevailing in other large cities, both of the new and of the old world.

How does the Boston of to-day compare with the Boston of the past? We find, in the first place, that our mean

death-rate for twenty years (1854 to 1873) is 24.54, and that the mean rate for the last five census years is 24.53. We find further that the mean rate for the first ten years (1854 to 1863) is 24.16, while for the second ten years (1864 to 1873) the mean rate is 24.95. There is a slight apparent increase in the second decennial period as compared with the first, but if we take the mean of the last ten years (1865 to 1874), using the death-rate for 1874, just published by the City Registrar (23.59), we again obtain 24.55.

We shall therefore consider 24.5 to be the mean general death-rate of this city.

Two circumstances, however, must be taken into account, before we can clearly understand the true significance of our past and present death-rates. In the first place, we know on the authority of the City Registrar himself (see report for 1859, p. 20), that our mortality returns prior to 1860 were less complete than they became subsequently, after the amendment of the registry law; consequently the death-rates obtained before that date, and belonging to the first decennial period, whose mean rate was 24.16, were probably somewhat understated. In the next place, since the year 1868, Boston has been successively annexing neighboring townships,* and as comparatively low death-rates habitually prevail in these suburban districts, the effect of counting in their deaths and populations with those of Boston proper has been to reduce somewhat the general death-rate of the entire city below what it would otherwise be.

The extent of the diminution of the death-rate of the city which is brought about in consequence of the annexation of the more healthy suburban populations is shown by the City Registrar; we here borrow his figures: —

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* Roxbury in 1868; Dorchester in 1870; Charlestown, Brighton and West Roxbury in 1874.

BOSTON DEATH RATES IN 1874.

	Per thousand.		Per thousand.
Roxbury . .	. 23.14	Brighton . .	. 16.74
Charlestown .	. 21.00	West Roxbury .	. 15.99
Dorchester .	. 18.00	East Boston .	. 15.00

The rate of Boston proper, exclusive of the districts named above, was 26.87, which is a considerably higher rate than that yielded by the entire city (23.59). The following* are the rates of Boston proper, minus the annexed townships, for the last ten years: —

	Per thousand.		Per thousand.
1865 . . .	. 23.6	1870 . . .	. 24.3
1866 . . .	. 22.4	1871 . . .	. 23.0
1867 . . .	. 22.3	1872 . . .	. 31.8
1868 . . .	. 23.9	1873 . . .	. 30.2
1869 . . .	. 23.4	1874 . . .	. 24.9

The mean of these ten yearly death-rates of Boston proper is 25. We find a slight increase in the mean rate thus obtained, as compared with that obtained for the first decennial period given above (24.16), and anterior to the annexations; but there is good reason to feel satisfied that this slight increase is only apparent, as it is probably due to more complete registration.

We will now compare our mean death-rate with the rates which prevail in other large cities; for this purpose a small number of examples will suffice. As isolated instances are of little value in statistics, the most trustworthy terms of comparison will be furnished by mean urban death-rates,

* Report of City Registrar for 1874, p. 16.

yielded by a number of cities grouped together, or by mean yearly rates of single cities covering a number of years.

In London and nineteen other large towns of the United Kingdom the death-rates during five years (1867 to 1871) averaged 26 per 1,000. The lowest rate, 19.3, was that of Portsmouth, in 1871, while Sunderland in the same year showed the highest rate, namely, 36.5.[1]

The mean death-rate of London during 32 years was 24.4; the decennial mean death-rates being as follows:[2] —

1840 to 1849 = 25.16
1850 to 1859 = 23.6
1860 to 1869 = 24.3

The average rate for the five last years (1865 to 1869) of this period was 24.5, which is also the average death-rate for the ten years comprised between 1862 and 1871.

London is often cited as an exceptionally healthy city, and, considering its immense population, it certainly shows a remarkably low death-rate compared with other cities of much less size. Nevertheless, as we have shown, the death-rate of Boston compares quite favorably even with this standard.

The following list[3] shows the mean death-rates that prevailed during five years (1867 to 1871) in twenty large towns of the United Kingdom. It will be seen that the mean rate of Boston (24.5) is equalled or exceeded in the case of all these towns except the five which head the list: —

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[1] See the 34th Report of Reg.-Gen. of England, pp. xc., xciii.

[2] See Report of Reg.Gen. for 1867.

[3] Reg.-Gen. 34th Report, table 32, p. xc.

Portsmouth	21.5	Bradford	26.0
Bristol	23.7	Sunderland	26.4
London	23.9	Leicester	27.0
Nottingham	24.2	Leeds	27.2
Norwich	24.4	Sheffield	27.4
Birmingham	24.5	Salford	28.3
Hull	24.8	Newcastle on Tyne	28.6
Edinburgh	25.6	Glasgow	31.0
Dublin	25.8	Manchester	31.7
Wolverhampton	25.9	Liverpool	32.0

Turning to other European cities, we will merely say that, with the exception of Paris, whose annual death-rates are comparatively low — the mean rate of ten years (1857 to 1866) being 25.1 — nearly all the chief capitals and cities of continental Europe show death-rates which considerably exceed the mean death-rate of Boston. We will not go into further details, but will now pass to the consideration of the mortality prevailing among urban populations of the United States, premising, however, that there is reason to doubt the accuracy of many of the death-rates yielded by the statistics of cities in this country, inasmuch as registration is in most of our cities far from complete. On the other hand, the populations of our cities are frequently exaggerated in the intervals of the census, so that, what with the deficiency of deaths and the excess of living, the death-rates are very frequently understated.*

* The following is an instance of the unreliable character of the low death-rates shown in the yearly reports of Boards of Health of some of our cities: In the third annual report of the Board of Health of Cincinnati for the year 1869, we find the death-rate stated at 14.38! If we look up the data from which this phenomenally low rate is obtained, we find that the population for 1869 was estimated at 260,000. In the report for 1868, the population was also estimated at 260,000, and the death-rate for that year was published at 18 05. Now, the ninth United States census states the population of Cincin-

In New York during the last five years (1870 to 1874) the following death-rates prevailed: 28.8, 28.6, 32.6, 27.9, 27.1. The mean death-rate of the five years is 29.0 per 1,000. The mean rate of Boston for the same five years is 26.0.

The mean death-rate of Philadelphia during a period of thirteen years (1861 to 1873) was 22.9 per 1,000. When we consider how large a city Philadelphia is, having in 1870 a population of 674,022 inhabitants, this mean death-rate certainly appears very low. Compared with the mean rate of Boston, the difference in favor of Philadelphia is 1.6.

Must we, then, admit that the sanitary condition of Boston is distinctly inferior to that of Philadelphia? Here comes up a new and complex question, which will have to be carefully investigated in another chapter; we will now only touch upon it incidentally.

In the "sanitary condition" of any community we have two classes of factors, one of which is apt to receive little or no attention. In the first place, there is the degree of *wholesomeness* of the locality, depending upon both its natural and

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nati to have been only 216,239 in 1870; so that the population for 1868 and 1869 was probably overestimated by a quarter, if not more.

Many of our large cities — especially those situated in the Western States — yield singularly low death-rates, in regard to which it is impossible not to be somewhat sceptical. Thus, in 1871, the following death-rates were claimed: St. Louis, 16.9; Buffalo, 13.9; Washington, 14.6; Cleveland, 19.5. Even this last-named death-rate, plausible as it may seem in comparison to some of the preceding very low rates, can hardly be accepted, when we take into account the high percentages of infant mortality prevalent in Cleveland. In 1873, deaths under one in this city (still-births deducted) were 29.5 per cent., and deaths under five were 49.1 per cent. of all deaths. Now, it is an established fact that large proportions of infant mortality are very significant of general defective sanitation, and it is hardly credible that a city in which such high percentages of infant mortality prevail can enjoy a low general rate of mortality.

Dr. C. P. Russel, Registrar of Records of the Board of Health of New York, agrees with us as to the fictitious character of the published death-rates of many American cities. (See Third Report of Board of Health of New York, 1873, p. 90.)

artificial hygienic characters; in the second place, there is the degree of *healthfulness* of the population. Evidently, in a population which is indigenous to the soil, being born and bred in the locality which it inhabits, the health of the inhabitants is the product of the hygienic influences among which they grow up. The degree of wholesomeness of the locality makes the good or bad health of the population, and, in any such case, it would evidently be impossible to recognize to what extent sanitary condition, as expressed by the general death-rate, might depend upon surrounding hygienic conditions (the "circumfusa," "applicata," "ingesta," etc., of hygienists) or upon the constitutional characteristics of the inhabitants.

But with such populations as inhabit this country the case is different. Throughout the United States the population is largely made up of foreigners. The number of these varies in proportion to the native element from place to place, and the nationalities of the predominating foreign elements also vary, as we have before said. These foreign-born immigrants come to live among us, bringing, at an adult age, previously acquired or inherited constitutional peculiarities and morbid tendencies which are not the product of the local influences among which the new-comers are to live, and which differ considerably from those which characterize our native population.

With us, then, a high death-rate may be due to either or both of the following conditions: unwholesomeness of the locality or unhealthiness of the inhabitants. The cause of undue mortality is, in one case, unfavorable climate or site, or defective sanitation; in the other case, constitutional weakness, which is of exotic origin, and, consequently, not imputable to our sanitary condition.

Now, does Boston constitute a less wholesome residence than Philadelphia? Or are Bostonians in general a less healthy population than Philadelphians? We think that we can show that the latter is to a certain extent the case, and

that herein is the explanation and cause of some of the sanitary traits observable in our community. For the moment we will only say that the populations of the three cities which we have been comparing — namely, Boston, Philadelphia and New York — differ in composition as regards nationality in such a manner and degree as to account to a certain extent for the differences presented by their death-rates and by their *apparent* sanitary conditions.

Thus New York, with a very high death-rate, has a population of which 45.5 per cent. is foreign-born, and of which 21.4 per cent. come from Ireland. Boston, with a lower death-rate, has 35.12 per cent. of foreigners, 22.71 being Irish. Philadelphia, with a still lower death-rate, contains only 27.25 per cent. of foreigners, the percentage of Irish being as low as 11.37. In this preponderance of the native element, whose constitutional superiority will be demonstrated in the next chapter, and in the small proportion of the Irish, whom we shall show to contribute to mortality in an extraordinary and disproportionate degree, exceeding in this respect not only the natives, but the Germans and the generality of foreigners, — in these circumstances, which are independent of climate and of sanitation, we have reasons which partially account for the comparatively low death-rates of Philadelphia and for its apparently superior sanitary condition.* Other reasons, by no means to be forgotten, are those habitually brought forward in explanation of the low

* The following figures are illustrative of some of the differences existing between the populations of Boston and Philadelphia: —

	Population.		Illiteracy. Unable to read, aged 10 yrs. and over. Per cent.	Deaths by Phthisis. Per cent. of all Deaths (10 years).
	Foreign-born. Per cent.	Irish. Per cent.		
Philadelphia	27.2	11.3	3.81	13.3
Boston	35.1	22.7	6.98	16.9

mortality of the "city of homes," as Philadelphia has been called; among others, the extensive area over which the city is spread,* and the consequent absence of tenement-houses, are frequently cited as reasons for the healthiness of Philadelphia.

We will not dwell longer on this point. Enough has been said for the time being to show that Boston, with a considerable foreign population (35.12 per cent.), and with the largest percentage of Irish (22.71) existing in any city in the United States, can hardly be fairly compared from a sanitary point of view with other cities more favorably circumstanced in having healthier populations, unless some allowance is made for this special factor of insanitary condition.

It may, perhaps, have been noticed that we have hitherto confined our remarks to the *mean* death-rate of Boston, and that we have made no comments upon the unusually and alarmingly high annual rates which marked the years 1872 and 1873. In these years the rate rose considerably above the previous mean — in 1872 to 30.5, and in 1873 to 28.4, and even the last published death-rate for 1874 we found to be as high as 26.87 for Boston proper, exclusive of the annexed townships. Are these high rates significant of permanently diminished health, of increased liability to death, of imperfect sanitation? We think that the excess of mortality which they represent can be shown to have been due, in great part, to the temporary action of transient causes, with whose disappearance the death-rate of Boston may confidently be expected to subside to the neighborhood of our previous mean, if, indeed, it do not fall lower still, in consequence of the favorable influence of the annexed suburbs.

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* Philadelphia, with an area of 129 square miles, or 82,700 acres, had a population in 1870 of 674,022 souls, making 5,225 inhabitants to the square mile. New York had 43,000 inhabitants to the square mile. — *J. Stockton-Hough, loco cit., p.* 600.

A brief analysis of the causes of death will, we trust, establish the correctness of the opinion which we have just expressed. In all communities the general mortality comprises, among its causes, *constant* (nearly) and *inconstant* factors; everywhere there are, on the one hand, endemic influences and generally diffused constitutional peculiarities which each year give rise to nearly the same proportion of deaths; and everywhere, on the other hand, sudden outbreaks of epidemic disease are liable to occur at intervals, sometimes with almost regular periodicity, superadding a variable amount of mortality to that which is due to the continuous action of the constant causes. Here, again, we have to touch upon a subject which must receive its due share of attention in a separate chapter; but we wish now only to exonerate our city from a suspicion of present and future excessive unhealthiness which it might incur, were it supposed that the recent rise of the death-rate were due to constant causes, and not, as we shall speedily show, to the passing influence of *epidemics*, which are only partially amenable to sanitation.

For the purposes of sanitary investigation, it is often expedient to separate from the general mortality that portion which is due to those infective diseases called "miasmatic zymotics," for it is among these that we find the diseases which assume an epidemic form. Eight of these, namely, small-pox, scarlatina, measles, typhoid fever, cerebro-spinal meningitis, whooping-cough, diphtheria (including croup), and diarrhœa (including cholera morbus, cholera infantum, and dysentery), we shall group together in order to ascertain the importance of the part which they play each year in the production of our mortality. Several of them, as typhoid fever and diarrhœal diseases, are *endemic* among us, and vary comparatively little in intensity from year to year; we shall, therefore, associate in another lesser group three diseases, namely, small-pox, scarlet fever, and cerebro-spinal meningitis, which are most intermittent in their attacks, and in the

most marked degree assume the form of epidemics. The following table exhibits, in the shape of *special death-rates*, the part played, in the last five years, by these variable, inconstant elements of our mortality: —

	1	2	3	4
YEARS.	General death-rates of Boston.	Death-rates by 8 zymotics per 1,000 living.	Death-rates by 3 epidemic zymotics per 1,000.	General death-rates minus the death-rates by 8 zymotics.
1870	24.34	6.11	0.96	18.23
1871	23.50	4.95	1.32	18.55
1872	30.53	9.71	3.98	20.82
1873	28.45	8.40	3.59	20.05
1874	23.59	5.00	0.92	18.59

In the last column it will be seen that, by subtracting the deaths due to the principal inconstant zymotics, we reduce the general death-rates to figures which vary comparatively little from year to year.

Column 3 shows the death-rate per 1,000 living by the three more distinctly epidemic diseases above specified, which have played the chief part in producing the high rates of 1872 and 1873. In 1872, when our death-rate rose to a height never attained since the cholera epidemic of 1849, small-pox caused 738 deaths, and scarlet fever 258 deaths; the three selected zymotics killed 1,056 persons, at the rate of 3.98 per 1,000. In 1873 the three epidemics raged simultaneously, small-pox causing 302 deaths, scarlet fever, 474, and cerebro-spinal meningitis, 216; taken together, they caused 992 deaths, at the rate of 3.59 per 1,000 living. The mean rate by the three zymotics during the last ten years is 1.71 per 1,000; this, subtracted from our mean general death-rate, leaves 22.8. Now, if the deaths which occurred in 1873 from these three epidemic diseases be subtracted from the general mortality of that year, the death-rate is

thereby reduced from 28.45 to 24.86, which is not greatly in excess of the mean rate given above, namely, 22.8 per 1,000.[1]

Looking at the matter in another way we reach a similar conclusion. During ten years (1862 to 1871) the mean death-rate by the eight selected zymotics was 5.88 per 1,000. In 1872, however, it rose to 9.71, and, in 1873, to 8.40, showing, in those years, an unusual prevalence of the physical conditions which favor the development of infective diseases and enhance their epidemic character. The differences between the mean decennial rate by these diseases and the corresponding annual rates of 1872 and 1873 amount respectively to 3.83 and 2.52 per 1,000. These differences represent the excess of deaths by zymotics during a period of high mortality due to the *temporary* excessive prevalence of epidemics. If, from the general death-rate of 1872 and 1873, we subtract the corresponding excess of zymotic death-rate, we obtain rates which are only moderately in excess of our mean general death-rate of 24.5 per 1,000.

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[1] The Boston Registration Report for 1873 contains the following statements under the heading "General Remarks" (see p. 53): "From an examination of the foregoing tables, it is evident that Boston cannot be congratulated on its sanitary condition. Without the presence of any epidemic, except scarlatina and small-pox, the former existing to no greater extent than for a number of years past, and the latter disappearing in July last, the death-rate appears in the ratio of 28.45 in a thousand. . . . The question very naturally arises, What is the cause of this remarkable change in the sanitary condition of Boston? The prevalence of epidemics does not account for it." — We cannot give our assent to these inferences, which are wholly at variance with our conclusions as set forth above.

The same objections apply to the views exposed in "An Inquiry into the Causes of the increased Death-rate of Boston and its Suburbs in 1872 and 1873," by Dr. M. B. Leonard, of East Boston. One of the conclusions of this paper is "that the impurities in our water-supply have increased the death-rate of Boston in the years 1872 and 1873." To determine the amount of morbific influence exerted by one out of the many causes of disease extending their effects over the entire city is a problem so complex as to be well-nigh insoluble. It is true that our water was somewhat less pure than usual in 1872–73, but the coincident increase of our mortality can, we think, be explained more satisfactorily than by this purely local cause.

Finally, a circumstance which shows conclusively that the high death-rates which prevailed in Boston in 1872–73 are not significant of increased and increasing *local* unhealthiness is the fact that *throughout the entire State of Massachusetts* the death-rate was unusually high in those two years. This is shown in the following series of yearly death-rates which we extract from the State registration reports: —

Years.	Yearly death-rate per 1,000.	Years.	Yearly death-rate per 1,000.
1866	18.15	1870	18.75
1867	16.91	1871	18.64
1868	18.52	1872	22.72
1869	18.38	1873	21.39

Our conclusion with regard to this point is that the facts and considerations set forth above invalidate any explanation attributing only to *local* causes, limited in scope to the city of Boston, the high death-rates of 1872–73; the causes of these exceptional death-rates must be sought in morbific influences of wide-spread activity, since their effects were by no means limited to Boston, but were apparent throughout the State. These temporary but wide-spread causes of disease were, in 1872, the violent epidemic of small-pox then raging, and the unusual prevalence of diarrhœal diseases occasioned by the extreme heat of the month of July.* In 1873 the causes of high mortality were the continuance of small-pox and the excessive increase of scarlatina, and of cerebro-spinal meningitis. In 1874 these morbific influences subsided, and our general death-rate fell below its average.

It is evident, then, from these facts and figures that our recent high death-rates are not significant of local unhealthiness, or of defective sanitation. It would no more be

* The mean temperature of the month of July, 1872, in Boston, exceeded the usual monthly mean of July by 2°.8.

admissible to say that Boston had suddenly become more unhealthy during the late years of excessive mortality, than it would be to pronounce a boy "unhealthy," because he was going through measles or scarlet fever.

Does it follow, from what precedes, that we are to rest wholly satisfied with our past and present sanitary condition? Such is certainly not our opinion. We have shown that Boston is not growing year by year more unhealthy, as has been thought to be the case; but that, on the contrary, her successive decennial mean death-rates maintain a remarkably uniform level; that, compared with other great cities, her sanitary state, all conditions being equalized, is quite good; we have also shown that the recent excessive mortality is only temporary, and implies no menace for the future. But because there are cities much more unhealthy than Boston, and because our sanitary condition appears, on the whole, quite satisfactory, we are not therefore to hold ourselves absolved from further efforts to improve our condition.

We shall show, further on, that there is every year a very considerable amount of *preventable* mortality in our community, and we shall have to point out the necessity for much sanitary work of various kinds. Without now going into details in regard to the excess of mortality which must be laid to our charge, we shall only attempt to show, as briefly as possible, to what extent our sanitary condition appears to fall short of that which may be assumed a fair standard of health for a large city.

In England it was enacted in 1848 (Public Health Act; Section 8), that "whenever in any place it should appear, from the Registrar General's returns, that the annual death-rate from all causes in such place had on a seven years' average exceeded the proportion of 23 to 1,000 of the population, the General Board of Health might send down an inspector to that place, and open an inquiry, with the

view of enforcing there the adoption of the Act."[1] According to this standard, Boston, if an English city, would be liable to an immediate incursion of officials, armed with full authority to enforce measures of sanitation. Judging by the mortality returns of the great majority of English cities, the General Board of Health must be kept pretty well occupied. But even if our mean rate were below the limit thus fixed, even if it were less than 23 in 1,000, we should not even then feel that the time had come when we might fold our arms in satisfaction. The only way not to fall short of what can and should be done, is to constantly attempt what cannot be done; we must always be striving after the unattainable, after perfection, even if we only hope not to fall short of what it is our positive duty to accomplish.

Therefore, although we have to deal with an urban population of the most unfavorable description, we should make it our aim to reduce our mortality to the level of such death-rates as prevail among rural populations; and it is all the more certain that, as long as our death-rate exceeds that of the country at large (21.6 per 1,000), which represents the mean of urban and rural rates throughout the United States, we must hold that much sanitary work remains to be done. Urban mortality almost everywhere exceeds rural mortality, although such is not invariably the case; the excess of deaths in towns is known to be chiefly caused by zymotic diseases, which class of diseases comprehends the majority of those which are distinctly amenable to sanitation. Let us therefore see in what proportion these diseases contribute to our yearly mortality.

The mean decennial death-rate of Boston (from 1865 to 1874), exclusive of the eight principal miasmatic zymotics, is but 18.28 per 1,000; the minimum and maximum death-rates so obtained differ only by 3.82, whereas the

[1] The London Lancet, Oct. 31, 1875, p. 633.

maximum and minimum general death-rates differ by 8.23. The death-rate by all diseases, *except the specified zymotics* (18.2), represents the death-rate to which we should make it our aim to reduce our mortality; the field for our sanitary operations being afforded by those very zymotics, of which a large proportion is due to removable causes, and therefore preventable.

An ingenious mode of testing the sanitary condition of a locality, and of estimating the extent to which its general death-rate exceeds the limits of thoroughly satisfactory sanitation, is used by N. A. Humphreys, in the paper from which we have already quoted. He contrasts the general death-rate of different cities with what he calls their "normal" death-rates, which are obtained by applying to the living population, at different ages, the mortality rates of the English life table for each selected age.* Hypothetical rates are thus deduced, which vary in accordance with the age-distributions of the localities compared, and not in accordance with degrees of mortality, since the same rates are applied in all instances. He then compares together the actual death-rate and the deduced "normal" rate of each city, and the extent to which the former exceeds the latter represents in each case the amount of sanitary work that is needed. We subjoin an extract from a table which exhibits the results of these calculations applied to eighteen English towns; below this list, we add figures relating to Boston, whose normal death-rate we have calculated for the last census year, in which the ages of the population are given.†

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* For an example of the calculation of a "normal" death-rate, see Appendix II.; where will be found the calculations by which the normal rate of Boston for the year 1855 is obtained.

† The reader may notice that the normal death-rate of Boston in 1865 (19.7) is lower than that of any English town, the lowest in Mr. Humphrey's table being 21. One reason of this difference is that the United States life

	General death-rate per 1,000, in 1871.	Normal death-rate, *i. e.* calculated from Life-Table Rates.	Difference between Normal and Actual Rate of 1871.	Death-rate in 1871, by selected Zymotics.
Total in 18 towns	26.9	21.7	5.1	6.5
Portsmouth	19.3	21.5	— 2.2	3.2
Bristol	23.2	22.1	1.1	3.5
Hull	23.2	22.1	1.1	4.3
London	24.6	21.8	2.8	6.0
Birmingham	24.9	21.5	3.4	5.4
Oldham	24.9	21.5	3.4	3.8
Bradford	25.5	21.0	4.5	4.6
Norwich	25.9	23.6	2.3	6.4
Nottingham	26.0	21.5	4.5	5.5
Leeds	26.4	21.8	4.6	5.4
Leicester	26.8	22.0	4.8	5.9
Wolverhampton	28.0	22.0	6.0	7.6
Sheffield	28.3	21.6	6.7	7.7
Salford	30.4	21.5	8.9	8.1
Manchester	31.2	21.3	9.9	6.9
Newcastle-on-Tyne	32.2	21.8	10.4	9.3
Liverpool	35.1	21.1	14.4	11.4
Sunderland	36.5	22.7	14.4	15.5
Boston, 1865	23.6	19.7	3.9	5.5

The difference between the actual death-rate of Boston for 1865 (23.6) and the normal death-rate (19.7) is 3.9,

table, calculated on the somewhat arbitrary assumption of a deficiency of 41 per cent. in the returns of deaths, comprises lower death-rates than those which belong to the English life table. The general death-rate at all ages of the U. S. life table is 21.6, while the English general death-rate is 22.4. Another reason why the normal rate of Boston is comparatively low, is that the birth-rate of Boston from 1860 to 1865 was remarkably low. This circumstance affects similarly both the real and the normal death-rate for 1865, so that the comparison of these two rates is perfectly admissible.

which shows to what extent the mortality prevailing in Boston in that year was in excess of the mortality of the country at large. It will be seen, by comparing columns 1, 3 and 4, that there is a nearly regular relation between the zymotic death-rate and the figure expressing excess of mortality; also that these two series of figures increase *pari passu* with the corresponding general death-rates, showing how trustworthy these are as indications of defective sanitation.

The conclusion of this chapter, and the answer to the question which we have taken for our text, is, that the death-rate of Boston, compared with her own past death-rates, or with those of the generality of great cities, can hardly be called excessive; but that her sanitary condition is, nevertheless, only *fair*, inasmuch as a considerable proportion of mortality takes place which is due to removable causes, and which calls for further investigation, and for measures of sanitation.

CHAPTER II.

In what portion of our community, as regards age and nationality, does the excess of mortality exist?

We have seen that the mean death-rate of Boston is 24.5, and that this rate represents an excess of mortality, which must be estimated at 4 or 5 deaths in 1,000 living (difference between the real and normal death-rates), if we are to be satisfied with a sanitary condition approximating that which prevails on an average throughout the United States or England.

We are now led to inquire *where* this excess of deaths is to be found, and whether it is uniformly diffused throughout our

entire population, or localized in some distinct groups of inhabitants; for, if we are to attempt to check the undue mortality, we must first ascertain precisely where the fault lies, in order that the remedy may be applied where it is needed.

In this respect, our city may be likened to an individual who is suffering from some apparently obscure disorder; the first care of his physician is to establish the *diagnosis*, by ascertaining the seat and nature of the disease, knowing that the treatment to be adopted must vary according to the nature of the affection, which may be general or local, acute or chronic.

To recognize the seat and the nature of undue disease in our community, to establish our "diagnosis," we must first investigate the age, the nationality (including both nativity and parentage), and the residence of decedents, and by comparing together the degrees of mortality which characterize different groups of our population as regards age and nationality, different districts of our city, and similar groups and districts in other communities, we shall be able to ascertain among what class of decedents the undue deaths take place. This being accomplished, our next step will be to investigate the nature and the causes of the diseases which occasion the yearly excess of deaths. We shall then be able to judge of the degree of preventability of the excessive mortality, and to prescribe suitable measures of sanitation.

Mortality at Different Ages.

The variations of mortality according to age are most accurately expressed in the form of a series of special death-rates distinguishing the ages of the living and dying. Unfortunately, for want of the requisite data as regards population, we can only calculate these death-rates for the two years, 1855 and 1865, in which our State census gives the

ages of the population divided in accordance with the exigencies of vital statistics. For the census year 1860, the population is known, but the deaths are wanting, the Registrar having failed to publish his yearly report. From the data relating to the two years, 1855 and 1865, we have constructed two series of death-rates at selected ages, and these have been condensed into a series of mean rates, which cannot differ much from the rates which habitually prevail among the population of this city, inasmuch as the general death-rates of the two years yield a mean which is exactly the decennial mean rate of Boston, namely, 24.5 per 1,000.

It is exceedingly interesting to compare this series of death-rates with similar rates belonging to other communities, whose sanitary condition appears more or less favorable. By such comparisons we are able to ascertain whether there is among our population an excess of deaths at any particular age. We therefore append a table which shows, 1st, the rates (mean of two years) prevailing in Boston. 2d, the rates of the life table of the United States. 3d, The rates of the English life table of 1841. 4th, The rates that prevailed in 1841 in London, in Liverpool, and in Surrey. This last-named community offers an example of rural mortality, while the national life-table rates represent means of urban (high) and rural (low) mortality.

Ages.	Boston. Mean of two years, 1855–1865. Death-rates per 1,000, living at each age.	U. S. Life Table. 1870. Death-rates	England. Life Table.		London. 1841. Death-rates.	Liverpool 1841. Death-rates.	Surrey. 1841. Death-rates.
			1841. Year of low Mortality. Death-rates	Means of 10 years. 1861–1870. Death-rates			
All ages	24.5	21.6	21.6	22.5	24.2	33.7	18.7
0–5 . .	96.2	62.6	63.49	68.6	82.27	136.21	46.5
5–10. .	9.21	9.27	9.38	8.0	10.23	15.92	9.77
10–15. .	4.32	5.66	5.27	4.5	4.30	6.92	5.81
15–20. .	9.14	8.50	7.59	. . . .	5.93	7.69	6.60
20–30. .	12.86	11.75	9.52	. . . .	8.48	10.48	7.81
30–40. .	15.29	13.42	11.22	. . . .	15.31	17.86	9.84
40–50. .	17.10	16.95	13.96	. . . .	18.90	26.57	13.21
50–60. .	25.35	25.00	22.05	. . . .	32.59	39.46	20.22
60–70. .	41.66	42.69	42.98	. . . .	58.34	73.99	41.90
70–80. .	94.84	80.65	95.63	. . . .	129.84	133.86	91.37
80–90. .	195.96	160.79	220.40	. . . .	251.93	220.14	266.70

The most noticeable fact to be deduced from an attentive study and comparison of these different series of rates is the *very great mortality which prevails in Boston among children under five years of age*. Out of every thousand of these, 96.2 die each year, while in London their rate is 82.2, and in the United States at large (town and country rates) it is only 62.6. Of all the communities instanced, Liverpool only, where the general death-rate (33.7 per 1,000) and the death-rate at each age are so very high, shows a death-rate among children higher than that which prevails in Boston. On the other hand, *at ages above five* the death-rates of Boston are quite low, even when compared with the rates of the national life tables of the United States and of England, notwithstanding the fact that these are derived from combined urban and rural statistics, and are therefore lower than such rates as usually prevail in towns. These interesting facts are

exhibited in a more striking light in the following epitomized table, which shows the death-rates per 1,000 living *under five*, *over five*, and at *all ages*, in Boston, in a group of twelve other cities situated in Massachusetts, in London, and in England. In calculating the mean rates for Boston at these specified ages, we have used, in addition to the rates of 1855 and 1865, other rates, obtained by means of the enumeration of our population which was made in 1870, at the request of the State Board of Health, and which gives the numbers living at certain specified ages in that year. The resulting mean general death-rate of these years (24.4) so closely approximates the general mean rate of our city (24.5), that the special rates at the ages specified must also be considered as constituting very close approximations to the true rates which habitually prevail at those ages among our population.

Deaths per 1,000 *living at specified ages.*

	Boston.				12 Cities in Mass., Boston not included.	London.	England.	
	1855.	1865.	1870.	Mean of 3 years.	1865.	Mean of 10 years. 1851–1860.	1841.	Mean of 10 years. 1861–70.
Under 1 . .	. .	265.5	276.9	271.2	229.8	. .	173.5	. . .
Under 5 . .	99.4	92.9	99.2	97.2	80.0	78.0	63-4	68.6
Over 5 . . .	14.7	15.6	15.5	15.2	14.0	16.6	15.3	. . .
At all ages	25.4	23.6	24.3	24.4	21.0	23.7	21.6	22.5

The most salient points to be noticed in this table are the high mortality prevalent in Boston among infants and children, and the comparatively low mortality among those more advanced in life. If we compare our mean death-rate *under five* and *over five years* with those of London, these facts become very apparent. It is remarkable that the mean rate among those aged five years and upwards in Boston should

be less than the corresponding rate of England in 1841, although this was a year of low mortality, when the general death-rate was but 21.6 per 1,000. But the mean death-rate of Boston among children under five exceeds that of England very considerably. Infants under one year fare almost as badly in Boston as in Liverpool. In this latter very unhealthy community in 1841, the death-rate under one was 281.3 per 1,000; in Boston, in 1870, it was 276.9. But at ages above one year, the mortality-rates of Liverpool are very much in excess of those of Boston; thus, during ten years (1851 to 1860) the death-rate under five in Liverpool was 131.9 per 1,000, and the general death-rate was 33 per 1,000.

In order to bring forward terms of comparison not exclusively derived from the vital statistics of European communities, and in order to exemplify, by statistics borrowed from our own neighborhood, the fact that such high rates of infant mortality as habitually prevail in Boston are not an inevitable necessity for all urban populations subjected to the influence of our climate and institutions, we have inserted, in the table given above, the mean death-rates under five, over five, and at all ages, yielded, in 1865, by twelve cities of Massachusetts, not including Boston.* In a later chapter, when discussing the causes and the degree and manner of preventability of our undue mortality, we shall try to show that it is not inevitably necessary that Boston should so transcend, in infant mortality, the other urban districts of the State. We now wish only to establish the fact that there is annually, in Boston, a considerable proportion of undue deaths, and that these occur mostly in the first years of life.

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* The twelve cities are the following: Fall River, New Bedford, Taunton, Newburyport, Gloucester, Lawrence, Lowell, Lynn, Salem, Springfield, Cambridge and Worcester. Their aggregate population in 1865 was 255,078. The mean death-rates given above are calculated from the data supplied by the State Census, and by the Registration Report of Massachusetts for 1865.

To show how important is the part played by our excessive infant mortality in swelling the general death-rate of this city, let us see what our death-rate would be, if the mortality among infants and children were less great, equalling, let us say, at ages under five years, that of the United States, that of England, or, to make a more plausible supposition, equalling only that of London.

In 1855, the general death-rate of Boston was 25.4. Deaths under five were 2,009 in number, being at the rate of 99.4 per 1,000 in a population of 20,193 children under five; on the other hand, 2,071 deaths occurred at ages above five, at the rate of 14.7 per 1,000 in a population of 140,297 who had passed that age. Now, if our mortality under five for that year had been that of the life table of the United States (62.6), or that of the latest English life table (68.6), or again that of London (78.0), our general death-rate in each of these imaginary cases would have been respectively 20.7, 21.5, and 22.7, instead of 25.4. Thus, by merely substituting for our own death-rate among infants and children that of London, whose death-rates above the age of five, be it remembered, are greater than ours, we reduce the deaths under five from 2,009, which was their actual number, to 1,575, the diminution representing 434 lives saved, and we reduce our general death-rate for the year 1855 from 25.4 to 22.7.

Of course, the special death-rates which we have quoted apply to the entire population, and are, consequently, compromises between high and low rates prevailing in different sections of the city. We shall see in the succeeding chapter, when discussing the influence of *locality* upon mortality, that there are districts where the death-rate under one year does not attain (Roxbury Highlands), or hardly exceeds (Ward 6), 100 per 1,000; while there are others (Wards 3 and 4, South Boston) where the rate under one year reaches or exceeds 400 per 1,000 living at that age.

Although we only know for three census years the precise rates of mortality prevailing at different ages, we can by other methods ascertain approximatively for other years the yearly proportions of infant mortality. These methods will enable us to compare successive periods of several years' duration, so as to form some idea of the variations which have taken place in the mortality of our community; they will also facilitate comparisons of Boston with other towns.

The second method of estimating infant mortality, to which we shall now have recourse, consists in ascertaining for each year the *ratio between deaths under one year, and registered births* (the *Dime Mortuaire* of the French). This method requires no data which are not obtainable each year from the City Registrar's report, and it gives results which are not vitiated by changes of age-distribution, nor by variations of mortality among adults, and which, as far as they go, are quite as exact and as easy of interpretation as are the death-rates at selected ages.

The mean ratio of deaths under one to births registered each year in Boston from 1865 to 1874 was 19.6, which means that to every hundred births there were each year nearly twenty deaths under one. The mean ratio for the first five years (1865 to 1869) was 18.7; for the second five years (1870 to 1874) it was 20.5; the highest ratios being those of 1872 and 1873, which were respectively 23.3 and 21.7.

The reader cannot fail to recognize how significant these figures are of excessive infant mortality. To comprehend their full import they must be compared with the following figures relating to seventeen large towns: [1] —

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[1] From the thirty-fourth annual report of the Register-General of England for the year 1871. Appendix, Table 20, p. 254.

	Death-rate per 1,000, 1871.	Percentage of Deaths under one year to Births.
Mean of 17 towns	26.5	19.2
London	24.7	17.1
Portsmouth	19.3	14.4
Norwich	25.9	20.0
Bristol	23.2	16.5
Wolverhampton	28.0	18.5
Birmingham	24.9	19.0
Leicester	26.8	24.1
Nottingham	26.0	18.7
Liverpool	35.1	26.9
Manchester	31.2	22.1
Salford	30.4	22.1
Bradford	25.5	20.9
Leeds	26.4	20.5
Sheffield	28.3	20.8
Hull	23.2	17.7
Sunderland	30.5	22.2
Newcastle on Tyne	32.2	22.3
Boston: mean of the last 10 years	24.5	19.6

We see by inspection of this table how high in Boston is the percentage of deaths under one to births. Such a high percentage as ours is only attained by the most unhealthy among the English towns; these combined yield a mean ratio of 19.2 deaths under one to 100 births, which is less than our analogous mean ratio for the last ten years, while the mean death-rate of the English towns is 26.5, exceeding the general death-rate of Boston by 2 per 1,000 living.

The inference is obvious, that there is certainly in Boston a much greater infant mortality than prevails in equally healthy English towns; and that infant mortality equalling

that of Boston is only found in English towns whose general sanitary condition, as represented by their general death-rate, is inferior to that of Boston.

Among the combined urban populations of France,[1] the mean *dime mortuaire*, or ratio of deaths under one to births registered during ten years (1856 to 1866), was 18.3, that of Boston being 19.6. In Paris, however, where infant mortality is excessively high, the death-rate under one reaching 290 per 1,000, the mean *dime mortuaire* during five years (1852 to 1866) was as high as 24.3.[2]

In thirteen towns of Massachusetts, not including Boston, the mean ratio of deaths under one to births, during ten years (1861–1870), was 17.3 per cent. The mean ratio of Boston during the same period was 19.1 per cent., and that of the rest of the State was 12.3.[3]

We shall not institute further comparisons between Boston and other cities of the United States, outside of Massachusetts, based upon the ratios of deaths under one to births, as the registration of births is too incomplete in the majority of our cities to admit of our applying this method, except in a limited number of cases.

Another method of estimating infant mortality consists in establishing for each year, in the shape of a percentage, the ratio of deaths under one year, and under five years of age, to deaths at all ages. This method is much less precise, as an indication of infant mortality, than the two

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[1] Démographie figurée de la France. Dr. Bertillon. Paris, 1874. p. 3. Carte IV.

[2] Infant mortality is comparatively low in the generality of French towns, but very high in the rural districts; in eight *départements* the death-rate under one was between 255 and 271 per 1,000; and in eight others it was between 277 and 369. In eight *départements* the *dime mortuaire* was between 21.8 and 23.9; and for all France, town and country, it was as high as 17.8; while that of England 1841) was only 15.8.

[3] See fourth annual report of State Board of Health of Massachusetts, article on Infant Mortality, by E. Jarvis, M.D., page 227.

methods which we have already described and used; but it yields sufficiently reliable results for our present purposes. It is less accurate than the preceding methods, because the ratios obtained are very considerably affected by variations of age-distribution, and by variations in the mortality prevailing at ages above one and five years.

Let us see how the mortality of Boston, viewed in this light, compares with that of other towns.

The following table exhibits the gradual growth of infant mortality in our community, as Boston, from a town of moderate size, with a population proportionate to the area which it inhabited, gradually outgrew its natural boundaries and assumed its present size.

	Boston. Years.	Percentage of Deaths under one year to Total Deaths.	Percentage of Deaths under five years to Total Deaths.
Means of 10 years	1820–29	8.73	25.69
	1830–39	12.66	35.17
	1840–49	12.76	37.52
	1850–59	23.84	46.49
	1865–74	25.40	41.70
Means of 5 years	1865–69	23.9	41.3
	1870–74	27.0	42.1
One year	1874	28.19	42.99

We see by these figures that the infant mortality of Boston, estimated by its percentage to deaths at all ages, has undergone a gradual increase from 1820 to 1860, so as to constitute in each succeeding decennial period a larger proportion of our general mortality. Our infant mortality, thus estimated, appears to reach its acme in the period of ten years preced-

ing the war and extending from 1850 to 1859; the mean percentage of deaths under five during this decennial period appears as high as 46.4, the years 1853 and 1855 being marked by the highest percentages ever reached in Boston, namely, 49.9 and 49.2.

After the war, however, from 1865 onwards, the percentages representing the proportion of deaths under five subsided to lower figures, the decennial mean falling from 46.4 to 41.7. Now, is this marked diminution of deaths under five real, or is it apparent? It is, unfortunately, only an apparent diminution, for it is but the result of the considerable diminution of our infant population which succeeded the war, and there is no reason to believe that the mortality at the early ages of life is any less now than it was when the percentages of infant mortality stood at their highest points; we have, indeed, already seen that the death-rate under five remained in 1870 at a very high altitude, namely, over 99 per 1,000.*

Indeed, instead of seeing in these percentages any signs of improvement, we find evidence of increasing mortality at early ages, especially in the first year of life. For, since

* It can be clearly proved that the diminution of our percentages of infant mortality implies no *real* improvement: —

In 1855 the percentage of deaths under five was 49.2, the death-rate under five being 99.4 per 1,000. In 1870 the percentage was only 43.0, but the death-rate still exceeded 99. This diminution of the percentage was wholly due to the falling-off of the proportion of children among our population, children under five in 1855 and 1860 being 12.5 per cent. of the aggregate population; whereas in 1865 they constituted only 10.3 per cent., and 10.5 per cent. in 1870. To prove that infant mortality remained as high as ever in 1865 and 1870, it is only necessary to raise to the proportion existing before the war, namely, to 12.5 per cent., the numbers of children under five living in 1865 and 1870. This being done, we find that deaths under five, at the rates which prevailed in those two years, amount in 1865 to 45.8 per cent. instead of 40.6, and in 1870 to 49.3 instead of 43, the hypothetical percentage of 1870 being very nearly as high as that of any previous year. It is here apparent how greatly the percentages of infant mortality are influenced by variations of age-distribution.

the war, during the period of five years extending from 1870 to 1874, the mean percentage of deaths under one has risen to an unprecedented height (27), and in 1874 this percentage was higher than ever before, being over 28. During the last five years (1870–1874) *over a quarter of all the deaths in Boston took place under one year of age*. This is partially due to the recovery of the *birth-rate*, which has been rising very regularly, by about one in 1,000 living, since 1864, when it was at its lowest point. Of course the increase of the birth-rate tells more rapidly on the proportion of deaths under one than on that of deaths under five; we may therefore expect to see the percentage of deaths under five continue to increase for several years more, as our population gradually regains its full quota of children under five years of age, unless we shall have succeeded in forestalling this result by sanitary measures, reducing the mortality among infants and children.

Let us now compare our last decennial (1865–1874) mean percentages, representing mortality *under one* (25.4 per cent.) and *under five* (41.7 per cent.), with analogous ratios belonging to other towns. Throughout these comparisons, however, we must continue to bear in mind that infants and children, whose deaths we offset against the deaths at all ages, constitute a comparatively small proportion of the population of Boston. There are two causes for the smallness of our proportion of children: it is partly due to the low birth-rates which prevailed during and since the war, and partly to the constant immigration which each year adds to the number of adults in our community. These two causes — one temporary, having now almost ceased to operate; the other constant in its action — lowered our ratio of children under five, in 1870, to 10.5 per cent.; whereas, in London (mean of 10 years, 1851–1860), children under five were 13.5 per cent., and in thirty town districts of England and Wales (same period) their ratio was 13.2 per cent. of the aggregate population.

In thirty towns of England and Wales, the mean ratio of deaths under five to all deaths, during a period of ten years (1851–1860), was 47.6 per cent.* This seems at first sight a high percentage. But, if we reduce the numbers living under five from their actual proportion, 13.2 per cent., to the proportion existing in Boston in 1870, namely 10.5, we find that the deaths under five, at the death-rate prevailing at that age (100.9 per 1,000), in these English towns, during the period specified, make only 41.9 per cent. of deaths at all ages. This low percentage, however, does not result from a low mortality at early ages, but from the high mortality above five; for the death-rate among those aged five years and upwards was 16.9 per 1,000.

In London† during the same period (1851–60) deaths under five were 43.8 per cent; but if here, also, the number living at that age is reduced to 10.5 of the aggregate population, so as to place London on the same footing as Boston, the percentage of death under five becomes 37.5, which, compared with our last decennial ratio (41.7), is quite low. In the case of London, this low percentage is partly the result of a low death-rate at early ages (78 per 1,000 under five), and partly the result of a rather high rate above the age of five (16.6 per 1,000).

The results obtained thus far show that this method of estimating infant mortality is very unsatisfactory; inasmuch as the disparities of age-distribution necessitate continual corrections, if we wish to institute tolerably fair comparisons under common conditions. This method is chiefly useful to us in enabling us to observe the progress and course of infant mortality in Boston, from the time of our earliest records of mortality down to the present day.

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* See Supplement to 25th Rep., of Reg. Gen., p. xxvi.

† Supp. to 25th Rep. of Reg. Gen., p. xviii, and p. 4.

In the twelve cities of Massachusetts already instanced, which do not include Boston, the mean ratio of deaths under one year to all deaths in 1865 was 21.6 per cent.; deaths under five were 40.1 per cent. of all deaths.

At this period the population of these twelve cities comprised, on an average, 10.4 per cent. of children under five years of age.

The latest (third) report of the City Registrar of Albany, for the year 1873, shows the ratios of deaths under one to have been 18.8 per cent., the ratio of deaths under five being 40.1 per cent. The general death-rate of the city was stated to be 18.8 per 1,000, and 40.1 per cent. of their general mortality represents 7.53 deaths under five years of age per 1,000 inhabitants of all ages. In Boston, in the same year, 1873, there were 11.89 deaths under five to every 1,000 inhabitants.

In Philadelphia the percentages of deaths under one in 1860, in 1867 and in 1873, still-births deducted,* were, respectively, 22.1 per cent., 26.9 per cent., and 27.8 per cent. The corresponding percentages of deaths under five were, in 1860, 42.8 per cent.; in 1867, 42.1 per cent.; and in 1873, 41.1 per cent.

To avoid burdening our report with a superfluity of figures we shall here bring these comparisons to an end, trusting that the examples already given may have sufficed to show that such rates of infant mortality as prevail in Boston are by no means necessary in any community, — not necessary even among the largest urban populations, — and that a death-rate of over 271 in 1,000 among infants under one year is *excessive* even for a large town subjected to the morbific influences of a New England climate.

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* In the yearly reports of the Board of Health of Philadelphia, these percentages appear much higher, because still-births are comprised in the calculations. Thus, during the last few years (1870 to 1873), the mean percentages of deaths under one and under five years were 28.4 and 43.38.

We do not wish, however, to make out that matters are worse with us than is really the case. Many instances of much higher rates and percentages of infant mortality * could be adduced, if we thought it necessary to show that Boston is not one of the most unhealthy communities of the civilized world. We have refrained from bringing forward such examples, however gratifying they might be as terms of comparison to those who have at heart the pre-eminence of Boston in matters of sanitation, because they seemed to us irrelevant, our object being now to show that cities *do* exist where infant mortality is much less high than it is in Boston, and that, consequently, a considerable reduction of our excess of early deaths must be possible.

The facts of the case are that much could and should be done to reduce our excess of deaths, *especially among infants and children*. We can at least try to bring down our *excessive* rates, namely, those at ages under five, to the level of those prevalent in certain other large towns, say in London. Let this be our standard for the present, and when success shall have crowned these our first modest efforts, then it will be allowable for us to take the higher standard adopted in England, and to consider as *excessive* all mortality in excess of the rates shown in our national life table.†

Influence of Nationality upon Mortality.

Over a third (35.12 per cent.) of the population of Boston is of exotic origin, being composed of foreigners who have migrated from the land of their birth to the United States, generally at some period of adolescence or of early adult life. Hence the division of our population

* See Appendix III.

† If the mortality under five in Boston had been that of the life table of the United States, namely, 62.6 per 1,000, the *general* death-rates of the years 1855, 1865, and 1870 would have been respectively 20.7, 20.4 and 20.0 per 1,000, instead of the actual rates, 25.4, 23.6 and 24.3.

into *natives* and *foreigners*. But this division, however valuable otherwise, is quite unsuitable for the purposes of sanitary science, inasmuch as our native population is made to comprise all the children of foreign parentage, born in this country. In consequence of this displacement of the native offspring of foreigners, the foreign population is very largely composed of adults, while the native population contains more than its quota of young lives. Populations so constituted cannot, as we have already said, be compared together with a view to determining the relative degrees of frequency of any events, such as births or deaths, occurring unequally among children or adults.

Is it, then, wholly impossible for us to know to what extent the native and foreign ingredients of our population differ as regards fecundity and mortality? No precise solution of this most interesting problem can be obtained, so difficult is it to separate and, as it were, to disentangle the closely interwoven populations, whose death-rates we wish to determine and compare. We shall not be able to ascertain exactly the respective degrees of liability to death of the native and foreign classes until we shall be supplied with the necessary data, comprising, on the one hand, census returns, giving together in one table the ages and parentage of the living, and, on the other hand, mortality returns, giving the ages and parentage of the dying.

An approximative estimate of the relative degrees of fecundity and mortality can perhaps be made if we use another division of the population, distinguishing no longer the *nativity* of the inhabitants, but their *parentage*, divided into native and foreign. By the last national census, of 1870, we know that of the population of Boston 58.4 per cent. were born to foreign fathers, the remainder (41.6 per cent.) being the offspring of native fathers. We have thus two distinct populations, the one comprising all the foreigners and their children, the other comprising all the natives, ex-

cept those whose fathers were foreign-born. But even this division, though less obnoxious to criticism than that founded upon nativity, is yet unsatisfactory, inasmuch as it also yields populations of dissimilar and somewhat abnormal age-distribution. The population of native parentage includes all native grandchildren of foreigners, who are thus displaced from the population to which they should by right belong; moreover, the population of foreign parentage is not a population of all ages,[1] inasmuch as foreign immigration in any considerable numbers only commenced about 1830; therefore the population of *aged* foreigners must be unduly small for a normally constituted population.[2] We have, however, in this division of our population, the nearest possible approach to accuracy, and as the registration reports of this city give us each year the births and deaths of native and foreign parentage (fathers), we can compare the relative frequency of these events among natives and foreigners.

In 1870, the population of foreign parentage being 58.4 per cent., the deaths of foreign parentage were 70.9 per cent. of all deaths. During the last ten years (1865 to 1874), the decedents of foreign parentage were 70.5 per cent. It is thus seen that the exotic element contributes disproportionately on the one hand to the population, and on the other hand to the mortality of the city.

Using the same facts in another way, we find that in 1870 the death-rate among inhabitants of native parentage in Boston was, *approximatively*, 17 per 1,000 living; while

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[1] See 25th Registration Report of Massachusetts, p. 60.

[2] This paucity of individuals above middle life accounts for the great apparent difference between the native and foreign classes as regards the mortality at different ages. In Massachusetts, in 1873, of all deaths under five, 61.3 per cent. were of foreign parentage, while of all deaths over fifty, only 30.7 were of foreign parentage. In 1867 the foreign percentage of deaths over fifty was still smaller, being only 22.2. It increases year by year, as the proportion of aged foreigners grows larger. If unmindful of the real cause of this small percentage of aged foreign decedents, one might imagine that it was due to the greater longevity of the native stock.

among inhabitants of foreign parentage, it was 29.5 per 1,000 living.

Dr. E. Jarvis estimates the rates of mortality among the foreign-born inhabitants of the United States to have been as high as 24 per 1,000 prior to 1850, and 26.25 per 1,000 from 1850 to 1860, and 22 per 1,000 from 1860 to 1870; these rates prevailed notwithstanding the favorable influence which the paucity of young lives among our foreign-born inhabitants exerts upon their death-rate. "The rates thus assumed," he says, "for the foreigners here are very high, almost double that of England for persons in the same ages."[1]

We have shown thus far that the excess of deaths in Boston is almost wholly confined to infancy, and that a disproportionate number of deaths occur among that portion of our population which, by nativity or parentage, is of foreign origin. We now wish to ascertain what proportions of our excessive infant mortality belong respectively to the native and foreign populations. We should have the most unequivocal testimony as regards this interesting question, if we could make out the death-rates which prevail at early ages among the offspring of native and foreign parentage; this, however, is impossible, for lack of the required data giving us the number of living and dying of each parentage at specified ages. We must, therefore, content ourselves with other methods less satisfactory, but still sufficiently trustworthy.

The registration reports of the city give each year the numbers of deaths of native and foreign parentage at various specified ages under fifteen. As we know also the births of native and foreign parentage, we have the data for determining the *dime mortuaire*, or yearly ratio of deaths under one

[1] Dr. E. Jarvis on "Immigration," in the Atlantic Monthly for April, 1872, page 457.

to births among natives and foreigners. The figures for Boston, covering a period of nine years (1866 to 1874), are as follows :—

Parentage.	Deaths under one per 100 births.
Native	17.9
Foreign	19.8

The State registration reports of Massachusetts contain the same data, which yield the following mean ratios, covering a period of seven years (1866 to 1873), and applying to the entire State : —

Parentage.	Deaths under one per 100 births.
Native	15.1
Foreign	17.0

It may perhaps be thought that the difference between natives and foreigners, thus expressed, is inconsiderable. It will, however, be found by calculation that if in Boston, in 1874, the percentage of deaths under one to births among the foreigners had been less by two, so as to equal the percentage yielded by the native population, the number of deaths would have been less by 157 ; the lives saved in one year of age only among our foreign inhabitants would have amounted to 157.

We are now led to inquire into the composition of this foreign population, whose great general liability to death has been made evident ; but before we turn our attention to the

sanitary condition of each of the different foreign races in Boston, it will be useful for us to pass in review certain interesting data relating to the foreign populations of the United States at large.

The foreign population of the United States, according to our last national census of 1870, amounts to 14.4 per cent. of the entire population of this country, and consists mainly of Irish (4.8 per cent.), of Germans (4.4 per cent.), and of English and Welsh (1.6 per cent.); of all the other nationalities, amounting together to 3.6 per cent., no one attains one per cent. Or, taking the foreign population by itself, the proportions of the predominant nationalities are as follows: Irish, 33.3 per cent. of all foreigners; Germans, 30.3 per cent.; English and Welsh, 11.2 per cent.; all other foreigners, 25.2 per cent.

It has been shown[1] that these different nationalities are characterized by widely different varieties and degrees of morbid tendency, thereby differing from the native population and from each other. As we have before said, it is very difficult correctly to institute comparisons between the natives and the foreigners. But, as General Walker has shown, the different foreign classes in this country can fairly enough be compared among themselves, without its being necessary for us to take into account age-distribution, since all these groups are constituted in a nearly uniform manner, and are, therefore, as regards age-distribution, all on about the same footing. Let us, then, see in what proportions each of the predominant classes of foreigners contributes to mortality by all diseases, and by various specified diseases, bearing in mind the proportion borne by each nationality to our aggregate foreign population.

The following table, borrowed from General Walker's paper, shows in a clear light the differences which exist

[1] See paper on the "Relations of Race and Nationality to Mortality in the United States," by Gen. F. A. Walker, Superintendent of 9th United States Census, in publications of American Public Health Association, 1873.

among the various foreign populations, compared among themselves, as regards mortality in general (deaths by all diseases), and as regards liability to death by various specified diseases. The same facts are exhibited in a more striking manner, perhaps, in the accompanying colored diagrams.

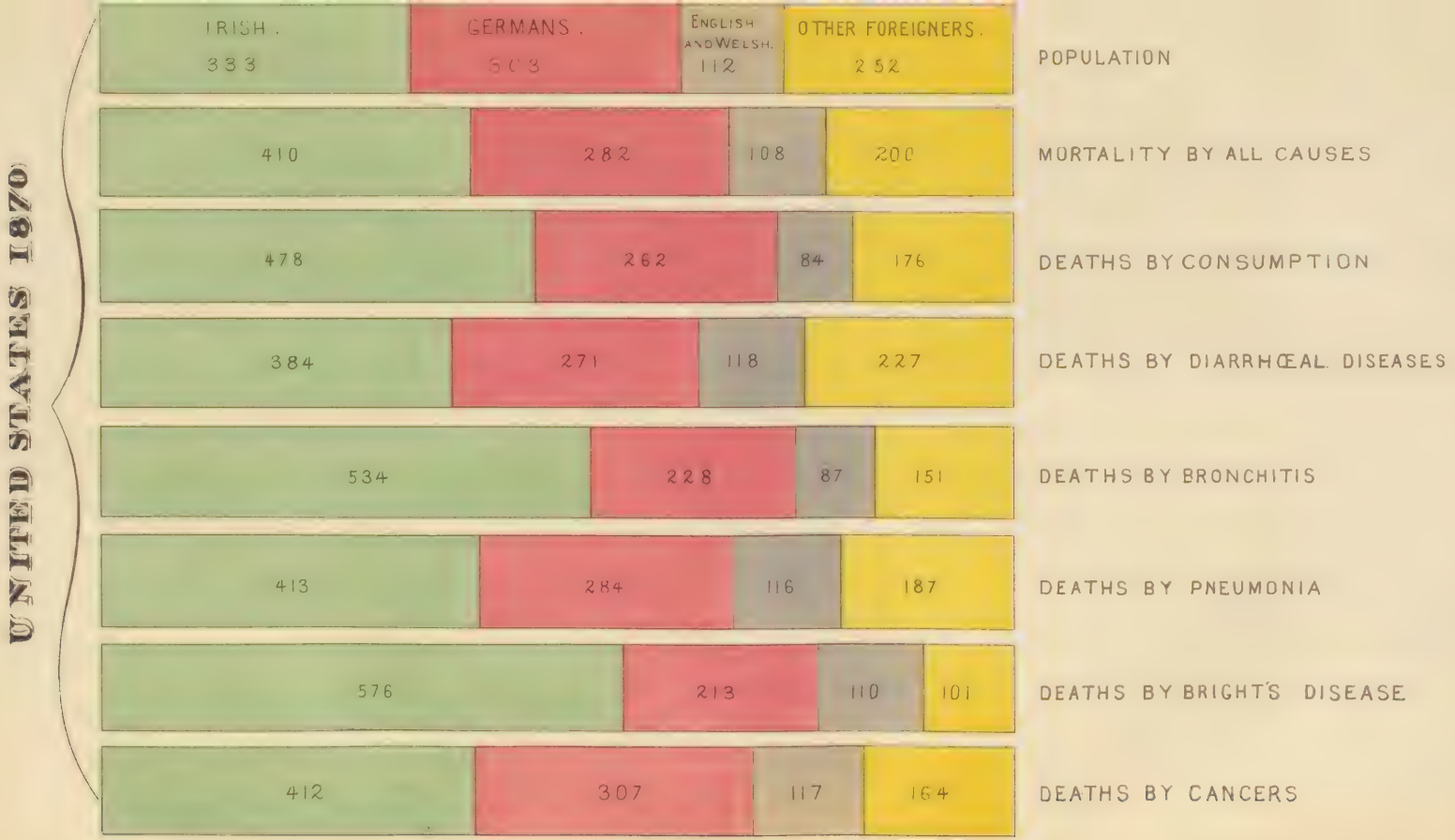
Table showing the proportionate Mortality of the various Foreign Races in the United States in 1870.

	Total Foreign.	Irish.	Germans.	English and Welsh.	Others.
Foreign population, U. S. A., 1870 . .	100	33.3	30.3	11.2	25.2
" decedents by all diseases . .	100	41.0	28.2	10.8	20.0
" " " Consumption .	100	47.8	26.2	8.4	17.6
" " " Bronchitis . .	100	53.4	22.8	8.7	15.1
" " " Pneumonia . .	100	41.3	28.4	11.6	18.7
" " " Diarrhœal diseases	100	33.4	27.1	11.8	22.7
Foreign decedents by Small-pox . . .	100	20.3	44.1	3.6	32.0
" " " Scarlet Fever and Diphtheria.	100	19.2	28.3	18.9	33.6
Foreign decedents by Measles	100	17.5	21.0	12.3	46.2
" " " Cancer	100	41.2	30.7	11.7	16.4
" " " Bright's disease	100	57.6	21.3	11.0	10.1

In this table we find striking instances of national liability to particular diseases, and of national immunity from other diseases. The figures should, in our opinion, be interpreted in the following manner: * —

If each and all of the races above tabulated were equally liable to death, and to each of the specified diseases, each

* Our interpretation of the figures shown in this table differs somewhat from that adopted by Gen. Walker. In the Appendix, Section V., will be found Gen. Walker's table in full, with the conclusions which he deduces from it.


UNITED STATES 1870
IRISH.
333
GERMANS.
503
ENGLISH AND WELSH.
112
OTHER FOREIGNERS.
252
POPULATION
410
282
108
200
MORTALITY BY ALL CAUSES
478
262
84
176
DEATHS BY CONSUMPTION
384
271
118
227
DEATHS BY DIARRHŒAL DISEASES
534
228
87
151
DEATHS BY BRONCHITIS
413
284
116
187
DEATHS BY PNEUMONIA
576
213
110
101
DEATHS BY BRIGHT'S DISEASE
412
307
117
164
DEATHS BY CANCERS

HELIOTYPE.

race would then *contribute equally to population and to mortality*, and the same figures would express its percentage to the aggregate foreign population, and to the total foreign decedents. The Irish, who constitute exactly a third part of the foreign population of the United States, would also contribute a third part, 33.3 per cent., of the deaths by all diseases, or by any one disease. But it may be seen, by the table, that in reality the Irish considerably exceed their quota (33.3 per cent.) of deaths, inasmuch as they contribute as many as 41 to every 100 deaths of foreigners. Again, the Germans, who number 30.3 in every 100 foreigners living in this country, only contribute 28.2 to every 100 foreign decedents; their general liability to death is therefore comparatively slight. Thus, whenever any nationality contributes more largely to deaths than to population among foreigners, the excess is significant of a disproportionate degree of liability to death by the diseases specified, and, conversely, whenever the percentage of any nationality to the aggregate foreign population exceeds its percentage to the aggregate deaths occurring among foreigners, then that nationality may be said to enjoy a comparative exemption from the diseases specified. The degree of liability or of exemption is to be measured by the difference between the contributions to population and to mortality.

For a detailed analysis of General Walker's most instructive table, we must refer the reader to the Appendix (section V.). In this context, we will only call attention to the characteristic features of the two predominant foreign nationalities of the United States, the Irish and the Germans, as deduced from the study of Gen. Walker's figures.

The Irish, as we have already said, considerably exceed their proportionate tribute to death by all causes; their quota of foreign deaths should be 33.3; it amounts to 41.0 per cent. Proceeding to the investigation of special morbid tendencies, we find that they exceed their quota of deaths by

all the diseases mentioned in Gen. Walker's table, excepting only the eruptive fevers, croup and diphtheria, cerebro-spinal, enteric, and typhus fevers, whooping-cough, paludal fevers, scrofula, and hydrocephalus. They exhibit a very excessive liability to bronchitis, and to Bright's disease, and a marked liability to consumption, cancers, pneumonia, and diarrhœal diseases.

The Germans show a comparatively slight liability to fatal disease in general, as they contribute considerably less to deaths than to population among foreigners. They contribute largely, however, and excessively, to the various febrile diseases, from which the Irish, on the contrary, are comparatively exempt; they are especially liable to suffer by the eruptive fevers, and small-pox in particular is very fatal among them. On the other hand, they show a certain degree of exemption from the diseases to which the Irish are most liable, namely, consumption, bronchitis, pneumonia, and diarrhœal diseases. Especially as regards deaths by Bright's disease is the difference between the Irish and the Germans surprisingly marked. To this disease the Irish contribution is 57.6 (instead of 33.3), while that of the Germans is only 21.3 (instead of 30.3).

Among the diseases to which we find that the Irish show a marked liability, by exceeding their quota of 33.3 per cent., are the following: —

Consumption, of which the Irish percentage is					47.8
Diarrhœal diseases	"	"	"	"	38.4
Pneumonia	"	"	"	"	41.3
Bronchitis	"	"	"	"	53.4

Now these diseases, in consequence of their constant and excessive prevalence, and of their great fatality, are the principal factors of our yearly mortality. Consumption, chiefly fatal among adults, has caused in Boston, during the last ten

years, 16.8 per cent. of all the deaths that have occurred. Diarrhœal diseases, prevailing principally among infants and young children, have caused, during the same period, 12.11 per cent. of all deaths. Bronchitis and pneumonia have together caused 8.6 per cent. of all deaths. These four classes of diseases have together caused over 37 per cent. of all the deaths that have taken place in Boston during the last ten years.

To sum up, it may be remarked that the diseases in liability to which the Irish considerably exceed their quota, and therefore transcend the other foreign nationalities, present the following characteristics: —

1st, They comprise those diseases which, in our community, are at all times the most widely spread and the most fatal (namely, bronchitis and pneumonia, consumption and diarrhœal diseases).

2d, They include constitutional diseases which are transmissible by inheritance (consumption and cancer), showing in the Irish an inborn predisposition to these diseases, which are thus imported by them into our community.

3d, They include diseases which are strongly significant of defective hygiene, both public and private, and of a widely spread prevalence of habits destructive to health (diarrhœal diseases, attributable to "filth"; Bright's disease of the kidneys, mainly dependent upon alcoholism for its cause,[1] etc.).

Now, when it is remembered that the Irish are the predominant foreign race in Boston, when they number 22.7 per cent. of the aggregate population and 64.6 per cent. of our foreign population,[2] and that Boston, of all the large

[1] Dr. Basham says that "intemperance brings more victims to chronic renal diseases than all the other causes put together." (Renal Diseases, London, 1870, page 125.)

[2] The proportion of Irish in Boston, and their importance from a sanitary point of view, are steadily declining. In 1855, the Irish numbered 28.7 per

cities of the United States, has the largest proportion of Irish inhabitants, the significance and the importance of these figures and facts will be recognized.

Let us now see if the foreign population of Boston exhibits national characteristics similar to those noted by Gen. Walker as belonging to the various foreign populations of the United States. As we have before said, the foreign population of Boston, which, in 1870, was 35.12 per cent. of the total inhabitants, consists mainly of Irish, who numbered 64.6 per cent. of all the foreigners in Boston. People from the British American Provinces (15.4), Germans (6.3), English (6.7), Scotch (2.0), and other foreign nationalities (each falling short of 1.0 per cent.), compose the remaining 35.4 per cent. of our foreign population.

Now, the Irish so predominate as to exceed in number all the other foreigners put together. We shall, therefore, direct the attention of our readers principally to this element of our foreign population, laying particular stress upon their national sanitary peculiarities in our attempt to elucidate the kind and degree of influence which they exert upon the sanitary condition of the city of Boston.

Resorting then to the mode of investigation used by Gen. Walker in his interesting researches upon the relations of nationality to mortality in the United States, let us compare

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cent. of the aggregate population, and 74.1 per cent. of all the foreigners in Boston. Now their percentage has fallen to 22.7. Each succeeding census shows a diminution of the proportion of Irish inhabitants in Boston, as well as throughout the United States. This diminution is of course due to the circumstance that Irish emigration to this country does not keep pace with the growth of our population. It may be interesting, in this connection, to note the fact that the Irish at home have since 1845 been slowly decreasing in numbers, as is shown by the results of the census, and this, notwithstanding that the *published* death-rates are remarkably low, so low in fact as to appear to the Registrar-General of England to be entitled to little or no credence. The population of Ireland was slightly less in 1873 than it was in 1803.

BOSTON 1870

POPULATION - DIVIDED ACCORDING TO PARENTAGE.

MORTALITY BY ALL CAUSES. DIVIDED ACCORDING TO PARENTAGE OF DECEDENTS.

FOREIGN POPULATION. DIVIDED ACCORDING TO NATIVITY

MORTALITY BY ALL CAUSES. AMONG FOREIGNERS.

DEATHS BY PHTHISIS - AMONG FOREIGNERS.

HELIOTYPE.

the contributions of our Irish inhabitants to foreign population on the one hand, and to foreign decedents on the other.[1] We find that in 1870, while their percentage to the total foreign population was 64.6, their percentage of foreign deaths was 73.2; and that during the last ten years (1865 to 1874) their contribution to foreign deaths was 72.5 per cent. So also, in 1865, the Irish, constituting 70.2 per cent. of our foreign population, furnished 76.0 per cent. of all the deaths that occurred among foreigners. It is therefore manifest that the Irish in Boston, as throughout the United States, constantly exceed, to a considerable extent, their quota of deaths, which would be the same as their contribution to population, did they not exceed the rest of our foreign inhabitants in mortality.

Consumption is the only specified disease respecting which the nativity of decedents is stated in the reports of the Registrar of the city. Let us see how the Irish fare among us as regards liability to this disease: —

In 1865, their percentage to foreign population being 70.2, the Irish numbered 77.9 per cent. of all foreign-born decedents by consumption. In 1870 their contribution to population was 64.6 per cent., while to consumption occurring among foreigners it was 76.2 per cent. During ten years (1864 to 1873), among all foreign-born decedents by this disease, 75.1 per cent. were Irish. These figures all testify to a marked liability to phthisis on the part of the Irish in Boston, as compared with the rest of our foreign population.[2]

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[1] See the accompanying colored diagram.

[2] The same characteristics are observable among the Irish in New York, as the following quotation, referring to deaths by *phthisis pulmonalis*, will show: "With respect to nationality, we have to notice the same peculiarities to which we directed attention the previous year (see First Annual Report of the Board of Health of New York, p. 245), viz.: the excessive death-rate among the Irish, as compared with the Germans." The following figures are also given: Irish population, 201,999; deaths by phthisis, 1,663. German population, 151,216; deaths by phthisis, 718. Total Irish mortality, 5,107.

All the foregoing comparisons between the native and foreign ingredients of our population, showing the superiority of the former over the latter as regards sanitary condition and bodily health, have been based upon vital statistics emanating from different communities of this country, in which the native and foreign races are living side by side under peculiar conditions. It may, perhaps, be objected to our deductions, that as our foreign population everywhere constitutes our poorest classes, *poverty*, with its attendant disadvantages, rather than nationality, is the real cause of the physical degradation, defective health, and excessive mortality which mark our foreign inhabitants, and especially the Irish, compared with the native stock. No doubt can be entertained but that poverty, together with the ignorance and heedlessness which generally accompany poverty, is a most potent factor in the production of disease and undue mortality, among our foreign inhabitants; but in addition to these causes, which will receive due consideration in Chapter III., we think that *nationality* exerts a most powerful influence, which, in the case of the Irish, is exceptionally marked.

Desiring to bring forward other proofs of the sanitary characteristics of this nationality in corroboration of the facts already adduced, we consulted the Reports of the Registrar General of Ireland. It soon became apparent, how-

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Percentage of deaths by phthisis on total mortality, 32.5. Total German mortality, 2,571. Percentage of deaths by phthisis on total mortality, 27.9. According to the last census throughout the whole United States, the percentage of deaths by consumption, upon total mortality for one year, was among the Irish 27.8, and among the Germans 22.2. (From the Second Annual Report of the Board of Health, New York, 1872, p. 211.)

From these figures we learn that in New York, in 1871, there were among the Irish 8.24 deaths by consumption per 1,000 living, while among the Germans there were but 4.74 deaths by this disease per 1,000 living. These, be it remembered, are not true death-rates, the populations used being anomalous; but the figures can be fairly compared together, and exhibit the relative degrees of liability to phthisis among Germans and Irish.

ever, that no additional light could be obtained from that quarter, on account of the utterly untrustworthy character of Irish registration reports.* Of the sanitary condition of the Irish at home we can learn little or nothing.

We know, however, that Liverpool, the most unhealthy of the great cities of England, owes much of its excessive disease and mortality to its large Irish population.†

We then had recourse to the published "experience" of Life Assurance Companies, and here obtained the conclusive proof that the national peculiarities which had appeared so striking in American health reports were not confined to Irish immigrants to this country, but prevailed with equal force in England, and presumably even in Ireland. A series of tables showing comparative *expectation of life* was published in 1843, by a well-known actuary.[1] One of his tables exhibits the expectation of life of the Irish, from the age of twenty upwards, based upon the results of Irish experience. We here append the figures, and, for contrast, we give them in connection with another table showing the Eng-

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*The published death-rate of Ireland in 1869 was 16.4 per 1,000! in 1871 it was 16.5! The Registrar General of England discards these rates altogether, with the following comment: "These rates," he says, "differ so widely from those of England and Scotland as to show either that registration in Ireland is extremely defective, or that the constitution or the circumstances of the population are altogether different from those of Great Britain." (34th annual Report of Reg. Gen., p. xxiii.) In his report for 1869 the Registrar General of Ireland says: "I may here observe that many persons die in Ireland unattended by any medical man, and that some physicians and surgeons object to the form of the certificate of the cause of death." (6th annual report, p. 126.) In connection with the low death-rates claimed for Ireland, it is curious to observe that the population of the country has been steadily declining ever since 1845; it was then a little over eight millions and a quarter; in 1873 it was under five millions and a half.

† See article on "The Social and Sanitary State of Liverpool," in the Lancet, Jan. 16, 1875, p. 96.

[1] See table viii. in "a series of tables of annuities and assurances," etc., by Jenkin Jones, Actuary, London, 1843.

lish expectation of life. The difference between the two series of figures is extremely marked.

Ages.	Irish Experience.	English Experience.
20	34.95	41.49
25	31.94	37.86
30	29.71	34.43
35	26.30	30.87
40	23.36	27.28
45	20.30	23.69
50	17.76	20.18
55	15.04	16.86
60	12.67	13.77
65	10.19	10.97
70	7.92	8.54
75	5.97	6.48
80	4.75	4.78

The author says that "from the Irish experience it appears that, of that class of assurances, at some of the younger ages, the expectation of life is as much as six years less than that obtained from the combined English town and country experience." He also says that "the offices generally are getting very cautious of Irish lives." A committee of experienced actuaries states that "one of the most striking features exhibited in these tables is the great mortality that prevails among Irish lives." [1]

The proofs of shortness of life and of excessive mortality contained in these figures, showing the Irish expectation of life, are certainly very striking, when we remember that one of the remarkable points in the comparisons of the ex-

[1] See Jenkin Jones, loc. cit. p. xvi.

pectations of life at different times, in different nations, and in various climates, is their great uniformity.[1]

In support of our assertion that the *native* population of this community enjoys a remarkably satisfactory sanitary condition, admitting of comparison with the best standards elsewhere, we have been led to compare together the experiences of American and English Life Assurance Companies. This comparison is all the more interesting that it affords almost the only means of eliminating from our vital statistics the influence of foreign mortality, inasmuch as life assurance in our community is, as we were assured by the president of one of our principal companies, limited almost exclusively to native lives.

Now, in a report published by the Mutual Life Insurance Company of New York,[2] we find a table showing the expectation of life among lives assured by this company during fifteen years, and placed in comparison with the English expectation of life, as exhibited in the well-known "actuaries' table of combined town and country experience." We here reproduce an abstract from these tables : —

Ages.	Mutual, N. Y., Experience of 15 years.	English Experience — Actuaries.
20	42.75	41.49
30	36.00	34.43
40	28.94	27.28
50	21.56	20.18
60	14.55	13.77
70	8.64	8.54

Commenting on this table, Mr. Homans, the actuary, says that the experience of the company gives a higher expec-

[1] See 5th Report of Reg. Gen. of England, p. 31.

[2] Report exhibiting the experience of the Mutual Life Insurance Company of New York for fifteen years ending Feb., 1858. Sheppard Homans, Actuary, New York, 1858, table X., p. 29.

tation of life below the age of seventy than that exhibited in any English table, except that of the "Friendly Societies," which is uniformly higher at all ages. Another table, borrowed from the same source (Table IX., p. 27), and contrasting the annual *rates of mortality* among American and English assured lives, corroborates the inference of the greater longevity and lesser mortality of the native Americans. In this table the American experience is subdivided into two columns, of which one shows the annual mortality during fifteen years throughout the entire experience of the company, while the other shows the mortality among assured lives in New England and the Middle States. It will be seen that the rates at different ages are less high by the American experience than by the English, and less high among New England lives than among the generality of American lives.

Ages.	Mutual Life Ins. Co., New York. 15 Years. Death-rates per 100 living.		English Companies.
	Whole Company.	Class I. (New England and Middle States.)	Total Experience up to 1838. Death-rates per 100 living.
15–25	1.10	.68	. . . .
25–35	.94	.73	.7910
35–45	.91	.76	1.1002
45–55	1.28	1.16	1.6146
55–65	2.55	2.79	2.9433
65–75	4.34	3.85	5.1769

In another table (Table IV., p. 15) the American experience is divided into five classes, according to locality, as follows: Class I. New England and the Middle States. Class II. The Western States. Class III. The Southern Atlantic States. Class IV. The Southern States on the

Gulf of Mexico. Class V. California. The annual rate of mortality among each class is given, and it will be seen that the rates increase among the different classes in the order of their enumeration, the mortality experienced among lives in New England and the Middle States being the least. The risks incurred by the company are of course found to increase proportionally to the rates of mortality, and extra annual premiums are calculated and charged to equalize the risks with those incurred in assuring lives in New England and the Middle States (Class I.), where the mortality is least high.

	Annual rates of mortality per 100 lives during 15 years.	Extra Annual Premium which should be charged to equalize the risk with Class I. Per cent. on total Premium.
Whole Company	1.09	. . .
Class I.	.96	. . .
Class II.	1.17	0.745
Class III.	1.31	1.147
Class IV.	1.88	2.867
Class V.	2.75	5.449

The upshot of the testimony adduced from the experience of Insurance Companies in England and in this country, is to the effect that: 1st. Among American assured lives (these being, as we have already said, almost exclusively *native*) the expectation of life is somewhat greater, and the rates of mortality are somewhat less, than among English assured lives. 2d. Of the generality of American assured lives the mortality is least high in New England and the Middle States. 3d. Among Irish assured lives the expectation of life is very considerably less than among English and American lives.

Let us now briefly recapitulate the foregoing facts bearing upon nationality considered in relation to sanitary condition and mortality.

We have seen that our foreign population, though undoubtedly more prolific than the natives, still more surpasses the latter in mortality.* This is seen to be true throughout the United States. In Boston the difference is exceptionally marked, inasmuch as the sanitary condition of our native population appears to be quite good, while our foreign population comprises large numbers of a nationality which is conclusively shown to be exceptionally liable at all ages to disease and death. These national characteristics, prevailing among an exotic population which, comprising foreigners and their offspring, constitutes 58.4 per cent. of our total population, and thus outnumbers the native inhabitants,

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*It is evident that we do not at all agree with certain writers (Clibborne, Schade, Kapp, Carlier, Allen, etc.), who have maintained that the native stock in the United States was fast dying out, in consequence of its infecundity and of its inability to become acclimated, and that the population of this country was only kept up by the immigrants and their offspring, which were supposed to be extraordinarily numerous in the first generation. We quite agree with the opinions expressed by one of our ablest statisticians, Dr. E. Jarvis, who has thoroughly exposed the fallacies of calculation and of inference upon which these inauspicious conclusions were based. (See Atlantic Monthly, April, 1872.) Dr. Jarvis says of our Irish population: "These Celts are very prone to marry, and their marriages are very productive, but it is yet doubtful whether their high birth-rate adds to the permanent population" (p. 463). He also says, "There is certainly no ground for the theory of the limited growth of the American, and of the unlimited growth of the foreign, element in the population of the United States; but, on the contrary, the natural increase is at a lower rate in the foreign than in the American families" (p. 468).

In the "Abstract of the Census of Massachusetts," of 1865, we find the following statement in corroboration of our view: From the foregoing considerations the conclusion is inevitable, that, notwithstanding the remarkable fact that the births among the native or American born, constituting about 79.00 per cent. of the total population of the State, are at present annually exceeded by the births among the foreign-born, constituting 20.95 per cent of the population, the native element is constantly gaining in numbers, owing to the relatively less mortality among those of early age" (p. 296).

exert an influence which must be taken into account when any attempt is made to estimate our sanitary condition. A considerable portion of our yearly mortality is the result of morbid tendencies inherent in our foreign population, and imported by them into our midst, and which must, therefore, not be attributed to defects in the surrounding hygienic conditions. In another chapter an attempt will be made to discriminate between these two orders of causes; those, on the one hand, which are imputable to unhealthiness of population, and those, on the other hand, which are due to unwholesomeness of climate or of site, to defects of drainage, of ventilation, or of water supply, and other agencies preventable or unpreventable, such as usually come under the jurisdiction of health officers. Our object now is only to show the part played by our foreign population in the production of our yearly mortality.

The precise number of deaths which are imputable to the foreign element cannot be ascertained. The foreign contribution to mortality certainly cannot be measured by the number of deaths registered and classified each year, under the various headings indicative of *foreign nativity* or *parentage;* yet it has been conclusively shown, that, even by this defective estimation, the responsibility of the foreigners is very great, and out of all proportion to their numbers. But much of the mortality existing among the so-called "native" population of Boston is more or less remotely attributable to a foreign, or, more correctly speaking, to a *Celtic* source. By no scheme can we go back further than one generation in any attempt to separate the native from the foreign stock. Yet it is impossible to doubt but that many of the most potent causes of disease and of death continue in operation through several generations among that part of our native population which is of comparatively recent foreign origin. Especially must this be the case among the Irish stock, which still so largely predominates among us. The hereditary

character of certain constitutional diseases (consumption, cancer), which are rife among this race, the hereditary and educational transmission of mental peculiarities which go to make up the national type of character, together with various unwholesome habits and traditions in matters of hygiene, all conspire, among the American-born of Irish descent, to maintain in continuous action throughout successive generations of naturalized foreigners (registered as natives) those potent causes of disease which are seen to be unmistakably active among the foreign-born of our population and among their offspring.

CHAPTER III.

What is the nature, and what are the causes, of the diseases which occasion our excessive mortality? To what extent and by what means are these diseases preventable?

We have already explained what we understood by the term *excessive*, as applied to a part of our annual mortality. We hold that all deaths are excessive which cause our actual mean yearly death-rate to exceed our "normal" death-rate, which is computed by applying to our existing population, at different ages, the death-rates of our national life table. The normal death-rate shows us what number of deaths would occur in Boston in the year, were the liability to death no greater in this city than that which prevails on an average throughout all the combined urban and rural districts of the United States. Judging by this modest standard, which affords us more favorable terms of comparison than we should find in the generality of purely rural death-rates, or even in

certain exceptional urban rates,* we must admit that our population sustains an average yearly excess of four or five deaths in every thousand living inhabitants.

Now, since this annual surplus of deaths occurs among us in addition to the average mortality which prevails throughout the country, it is but natural to infer that the extra deaths must be due to certain unfavorable conditions, which, in Boston, are superadded to the ordinary sources of disease existing in the generality of communities in the United States. These particular morbific conditions we propose to investigate, with a view to determining whether or not they are removable. Our project, then, is to try to determine the nature, and, as far as may be possible, the causes of those particular classes of diseases which characterize the sanitary condition of urban communities in general, and of the City of Boston in particular, as compared with rural districts. From such knowledge of the causation of these diseases as we may possess we may be able to deduce effective measures of prevention.

The following list shows the principal headings under which deaths are registered and tabulated in Boston, and the mean ratio of deaths attributed to each class of diseases to every hundred deaths by all causes, during ten years. Deaths caused by all these diseases together represent 70 per cent. of our total mortality.

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* Portsmouth, in England, in 1871, returned a death-rate of 19.3 per 1,000; the normal death-rate, being 21.5, exceeded the actual death-rate by 2.2. The mean death-rate of Croydon, during thirteen years that have elapsed since the construction of sanitary works, has been 18.6 per 1,000.

Diseases.	Mean Percentage to Total Deaths. 1865 to 1874.	Diseases.	Mean Percentage to Total Deaths. 1865 to 1874.
Accidents	3.55	Hydrocephalus	2.33
Apoplexy	1.49	Diseases of the Kidneys. .	1.50
Diseases of the Brain . . .	5.11	Measles	0.52
Bronchitis	2.63	Pneumonia	6.19
Cholera Infantum	8.02	Puerperal Diseases* . . .	2.12
Consumption	16.80	Scarlatina	3.85
Diarrhœal Diseases	12.11	Small-pox	2.37
Diphtheria and Croup. . . .	2.40	Typhoid and Typhus Fever	2.70
Diseases of the Heart . . .	3.17		

Now, the various diseases comprehended under the headings used in our registration do not all, by any means, interest us equally. Thus, "apoplexy" has caused only 1.49 per cent. of all deaths during the last ten years; consequently the fatal diseases reported under this heading (cerebral hæmorrhage, cerebral embolism, etc.) are of little consequence compared with other diseases whose contribution to our yearly mortality is very much greater; moreover, inasmuch as these diseases causing apoplexy must be considered as unpreventable by any measures of public hygiene, they offer little or no interest from the point of view of sanitation. Diarrhœal diseases, on the other hand, cause each year a very large proportion, over an eighth, of our total mortality; we know, moreover, that of the various diseases comprehended under this designation, a very large proportion is due to distinctly removable causes, and that these diseases and their ascertained causes belong almost exclusively to urban districts, of whose sanitary condition they constitute

* The percentage of deaths by puerperal diseases relates only to deaths occurring among females, of which 2.12 per cent. were due to this class of diseases.

characteristic features; we know also that in Boston the mean yearly death-rate, by these diseases alone, has amounted during the last ten years to 3 per 1,000 living, representing nearly the whole of our yearly excess of deaths. Here, then, is a proper field for careful investigation, and for sanitary intervention. Guided by such considerations, out of the various classes of diseases whose respective shares in the production of our yearly mortality are exhibited in the table above, we shall select for special attention those diseases whose known or surmised causes appear likely to be amenable to prevention by sanitary measures. The others we shall pass over.

The most important among the diseases which may be considered as due to removable causes, and, consequently, preventable, are comprehended under the following headings: —

1st. Certain infective diseases, which, in accordance with the nomenclature most generally used by writers on vital statistics, we shall call "*Zymotics*" (zymotics of the so-called *miasmatic* order, of Farr's classification). Eight of these, namely, small-pox, scarlet fever, measles, cerebro-spinal meningitis, whooping cough, diphtheria (including croup), typhoid fever, and diarrhœal diseases, have together caused during the last ten years over a quarter of all the deaths in Boston. These diseases shall be considered associated in a group, and separately.

2d. *Consumption.* — Tubercular disease is very rife in Boston, causing each year a constant and very large proportion of our mortality. Of all deaths, over 17 per cent. have been due to phthisis pulmonalis. For this reason alone, even if not very sanguine of being able to suggest effective and practicable measures of prevention, we shall devote some attention to the presumable causes of the excessive prevalence of this disease among the inhabitants of Boston.

3d. Other diseases of the *respiratory organs*, comprising

chiefly bronchitis and pneumonia. These two affections have caused nearly 9 per cent. of all our yearly deaths. Though they are undoubtedly due to removable causes, and are, to a great extent, preventable diseases, still their prevention belongs almost entirely to private hygiene, and hardly at all to sanitation. The mortality to which they give rise, however, is so large, especially at the extreme ages, that they can hardly be passed over without notice.

4th. *Infant Mortality.* — Under this term, which can have no place in any systematic nosology, a great variety of diseases are of course included, the principal among them being several of the "zymotics" (diarrhœal diseases, eruptive fevers), and the acute affections of the respiratory organs, all of which are to receive attention separately. Still, for reasons which are sufficiently obvious, it is desirable to investigate the general subject of infant mortality by itself, with reference to its causes, and its prevention, even at the risk of some repetition of what may have already been said.

I. Zymotics.

Each of the diseases which are comprehended under this common designation is supposed, with more or less certainty, to originate in the *infection* of the system by certain poisonous matters derived from without. Of these various poisons, specific or unspecific, which constitute the *materies morbi* of infective diseases, we know as yet little with certainty, beyond their effects and certain of the conditions under which they exist and are active. The little that we do know, however, has proved extremely valuable, by virtue of the light which is thereby thrown upon the pathogenesis, and, secondarily, upon the prevention of several of the diseases which are most fatal among mankind.

The prevention of disease by means of sanitary measures, whether belonging to private or to public hygiene, can

hardly be accomplished except under two conditions. In the first place, we must know the determining conditions under which diseases orginate, or are transmitted. In the second place, these conditions of origin or of transmission must be subject to control by agencies which it is within our power to apply. In other words, such diseases only are preventable as are due to removable causes. In the study of the causes of endemic and of epidemic disease, therefore, lies the hope of sanitary science.

The subject of morbific poisons is one of the great and moving questions of the present time. New facts and new hypotheses are continually being accumulated, and the most diverse opinions as to their value and significance prevail among the pioneers who are laboring in this rich and extensive field of medical research. In our present inquiry we shall have to confine our attention to such facts and theories as appear likely to be of practical value, by virtue of the means of prevention which they may suggest. This narrow stand-point must be consistently adhered to, if we wish to avoid endless discursions beyond the proper limits of our subject. We shall therefore not refer to recent most interesting investigations and discussions respecting the nature and the origin of the infecting matters which are supposed to constitute the seeds, as it were, of the infectious diseases. Whether these matters are organized and living (*contagium vivum*) or only organic; whether, if living, they are invariably reproduced by germs, or may owe their origin to spontaneous generation; whether they are active by themselves or through their products; whether they are essential or not to fermentative and putrefactive processes occurring within or without the system, — all these mooted questions must be laid aside. What concerns us in connection with these poisons is, first, their *effects*, by which we recognize their existence; secondly, the *conditions of their activity*, whereby the transmission of infectious disease takes place, and finally,

the *preventive agencies*, by which their origin, their reproduction, or their evolution may be controlled. Fortunately for the purposes of sanitary science and of the present inquiry, of the little that is known about the infective poisons, these points are those in relation to which we possess the most accurate information.

We shall now consider separately each of the leading "zymotics," with reference to its consequences, its causes, and its prevention.

Small-Pox.

The following table shows the yearly deaths by small-pox, in Boston, since the year 1811 :—

Years.	Deaths.	Years.	Deaths.	Years.	Deaths.
1811	2	1833	. . .	1855	132
1812	. . .	1834	4	1856	78
1813	. . .	1835	7	1857	2
1814	. . .	1836	6	1858	3
1815	4	1837	13	1859	156
1816	. . .	1838	3	1860	162
1817	. . .	1839	60	1861	7
1818	. . .	1840	115	1862	13
1819	. . .	1841	57	1863	11
1820	. . .	1842	42	1864	113
1821	. . .	1843	55	1865	115
1822	. . . .	1844	. . .	1866	51
1823	. . .	1845	31	1867	144
1824	1	1846	92	1868	8
1825	1	1847	23	1869	6
1826	. . .	1848	21	1870	32
1827	3	1849	21	1871	28
1828	2	1850	192	1872	738
1829	. . .	1851	63	1873	302
1830	. . .	1852	12	1874	2
1831	4	1853	6		
1832	2	1854	118		

From these figures we learn that small-pox, after having almost wholly disappeared from our community during the thirty or forty years which followed the introduction of vaccination, in 1800, gradually regained its footing in Boston, where it has continued to prevail almost uninterruptedly, although with varying intensity, from 1839, when the disease for the first time assumed the form of a distinct epidemic, up to 1873.* During this period of thirty-five years the course of small-pox has been marked by a succession of epidemic paroxysms, generally lasting from one to two years, and separated by intervals of several years, during which a varying number of sporadic cases testified to the constant presence of the disease.

Considering now the proportion of our yearly mortality due to small-pox during successive decennial periods, we find that the mean percentages of deaths by small-pox to all death have been as follows: —

Years.	Deaths by Small-pox, to every 100 deaths.
1835 to 1844	1.92
1845 to 1854	1.50
1855 to 1864	1.71
1865 to 1874	2.36

The latest epidemic, that of 1872–1873, was the most severe that has been experienced in Boston since the introduction of vaccination, having proved fatal to 1,040 persons. In 1872 the death-rate by small-pox was 2.78 per 1,000, and

* In 1797 an "act to prevent the spreading of contagious sickness" was passed. This act provided for the isolation of infected persons. In April, 1838, this law was repealed, with disastrous results which are clearly apparent in the table on the preceding page.

the percentage of deaths by this disease amounted to 9.11. In 1873 the death-rate was 1.57, the percentage being 5.54. Since the summer of 1873 the disease has almost wholly disappeared.

The ages at which the 738 deaths occurred in 1872 were as follows: —

	Under 5.	5 to 15.	15 to 20.	20 to 30.	30 to 40.	Over 40.	Total.
Numbers . . .	190	43	84	267	92	56	738
Percentage. . .	26.5	5.8	11.3	36.0	12.4	7.9	100

Of the 738 decedents as many as 583, or 79 per cent., were of foreign parentage. In this connection it should be remembered that our population, by the census of 1870, contains 58.4 per cent. of inhabitants of foreign parentage. Their liability to small-pox is therefore very marked, as compared with that of the inhabitants of native parentage.

Of all the foreign-born decedents by small-pox in 1872, only 31.1 per cent. were Irish, which result corroborates Gen. Walker's statement that the Irish in this country enjoy a marked exemption from this disease, as well as from the eruptive fevers in general. On the other hand, of all the foreigners dying of small-pox, as many as 41.4 per cent. came from the British American provinces, although inhabitants of that origin constitute only 15.4 per cent. of our foreign population. Here we have evidence of an *excessive liability to small-pox*, which can be due to only one cause, namely, neglect of vaccination. In this connection we shall recall the warning words of the late Secretary of the State Board of Health. Writing in 1871, at the very commencement of the late terrible epidemic, he said: [1] "Small-pox has found

[1] Third Annual Report of the State Board of Health of Massachusetts, 1872, p. 300.

a secure foothold in very few places. Among the twenty most populous cities and towns, it has been epidemic in Lowell and Holyoke, and in none others. Boston has been almost entirely exempt, and the same may be said of the large cities in its immediate vicinity. In many smaller places cases have occurred; but the disease has only spread in Lowell and Holyoke, and there can be little doubt that it would have been quickly extinguished there, if, *at the first outbreak*, the health authorities had acted with more promptness and decision. '*Principiis obsta*' — stop the beginnings — can have no more useful application than in dealing with small-pox; and that this has not always been done is partly, at least, the fault of the State laws relating to the subject. Lowell and Holyoke have a large foreign population of young persons, including many French Canadians. These people are notoriously perverse in refusing vaccination, and, when sick with small-pox, conceal, if possible, the nature of their disease. Neither their ignorance nor their foolhardiness should be allowed to endanger the lives of those among whom they dwell."

The wards in which the epidemic of 1872 caused the greatest loss of life were Wards 2 and 7, in which there were respectively 222 and 86 deaths, making 58.3 per cent. of all the deaths by this disease outside of public institutions.

With regard to the causes of small-pox we know that the disease spreads exclusively by means of a specific virus which is derived from the body of a small-pox patient, and which is conveyed directly, or indirectly, to a predisposed person, thus causing the outbreak of the disease in the latter. The conditions of the transmission are, therefore, 1st. A predisposition to contract the disease. 2d. Contagion, immediate or mediate. The means of prevention should be directed against both of these two sets of conditions, and consist in, 1st. The vaccination, or the re-

vaccination of the predisposed individual. 2d. The isolation of the diseased.

1st. Vaccination. It is no doubt sufficiently well known that in vaccination, efficiently carried out, we possess a means of prophylaxis by which small-pox becomes of all diseases the most surely preventable.[1]

This fact is so thoroughly established as to be quite beyond question. We need not, therefore, make any attempt to set forth the value of vaccination, but will content ourselves with referring our readers to a document[2] in which the question of small-pox in its relations to vaccination, together with the subject of vaccination in all its details, are exhibited in the clearest and most convincing light.

The paper on vaccination, by Dr. James C. White, to to which we allude, is summed up in the following conclusions: —

"1st. That the introduction of vaccination acted as an immediate check to the frightful ravages of small-pox in all parts of the world. That it destroyed the susceptibility to

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[1] Dr. Farr estimates that in England, during the late great epidemic of 1871, out of the same numbers living, six times as many unvaccinated persons were attacked as vaccinated. Among the unvaccinated, 45 per cent. of the cases terminated fatally, while among the vaccinated the deaths were 10 per cent. "Vaccination, then, does not afford entire immunity against attack or against death by small-pox; but it unquestionably affords protection, to a large extent, against attack, and in the event of attack it renders the disease much less fatal than it would otherwise be.

"To illustrate the relative protection, assume, merely for illustration, that in 100,000 vaccinated persons 100 are attacked and treated in the hospital; then, as we have seen, 10 of them die.

"Now take 100,000 unvaccinated people, exposed to nearly the same sources of infection, then, according to the previous data, at least 600 would be attacked and treated, of whom 270 would die." (From letter to the Registrar General of England. Thirty-fourth Annual Report, etc., London, 1873. Appendix, page 219.)

[2] See Memorial of the Boston Sanitary Association, presented to the Senate and House of Representatives of the Commonwealth of Massachusetts, by John Ware, Robert Ware, and James C. White, committee, March, 1861.

the disease in the individual as completely as inoculation or a previous attack of small-pox, without the danger or inconvenience which accompany the latter. That through its action epidemics of small-pox have become far less frequent than formerly, and their mortality has been reduced to a great extent. That its success has been greatest in those countries where its universal employment has been made compulsory.

"2d. That the protective power of vaccination is absolutely the same to-day as it was in the time of Jenner.

"3d. That the immunity conferred by vaccination is not alike, either in amount or duration, in all persons. That the history of epidemics teaches that small-pox will attack a definite proportion of the vaccinated, if exposed to its influence. That post-vaccine small-pox is very rare before the tenth year in children, and that it increases in frequency from the age of 12 to that of 25. That after the age of 35 the inherent predisposition to take small-pox seems to die out to a great extent in the protected and unprotected.

"4th. That we possess in revaccination our only means of ascertaining the condition of individual security at any time, and of affording it when found wanting. That the large proportion of cases in which revaccination is found to be successful, its influence in preventing the rise and spread of epidemic small-pox, the renewed safety it affords persons of all ages, and the unanimity of European governments in making its performance compulsory so far as possible, are sufficient grounds for any action the association may deem proper to take to render its employment among us more general.

"5th. That there is no sufficient evidence to show that the vaccine virus now in use has degenerated in any way since the days of Jenner, or that there is any necessity to resort to the cow for a fresh supply.

"6th. That the operation of vaccination and revaccination

is perfectly safe in itself, and the popular opinion that diseases may be introduced into the system when properly performed is entirely erroneous, and should be eradicated from the popular mind.

"7th. That the recent epidemic (of 1859–1860) conclusively shows that a great neglect of the proper precautionary and preservative measures prevails in the community, and that some more effective means than those now employed should be adopted to prevent its recurrence in the future."

2d. Isolation. If small-pox patients could be strictly isolated, epidemics would become impossible, the disease would doubtless disappear, and an immense saving of life would be the result.* Isolation, either at home or in public institutions, should be practised in all cases of the disease, whether mild or severe, whether varioloid or variola, throughout the entire duration of the disease, from the stage of invasion until the crusts have completely fallen off.

Not only should immediate contagion be prevented by the sequestration of diseased individuals, but we should try to forestall all chances of mediate infection by reducing to a minimum the coming and going of persons who attend to the sick. Moreover, as the bodies of those who have succumbed to small-pox are capable of conveying the disease, precautions should not cease with the life of the patient. The clothing, bedding, etc., should be destroyed, or else disinfected by *efficient* means.

Such are the measures by which we may limit, if not absolutely prevent, the spread of small-pox.

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* The efficacy of isolation is sufficiently exemplified by the disastrous consequences which, from 1839 to 1873, followed the repeal of the law of 1797, providing for the isolation of infected persons, as well as by the immediate extinction of the disease which ensued in the summer of 1873, when the new law of 1872, giving sufficient powers to our Sanitary authorities, was enforced by our present Board of Health.

Now, have these means of prevention been applied in such a way as to yield to our community their full measure of protection against small-pox? Most certainly not.

In the years 1859–1860 an epidemic occurred which caused in Boston 318 deaths by small-pox, amounting to 3.91 per cent. of all the deaths that occurred in the two years. In 1861 the Suffolk District Medical Society, after a careful examination of the history of small-pox in Boston and in this State, unanimously adopted the following resolutions, which were presented by a committee appointed to confer with Dr. John Ware, of the Boston Sanitary Association: —

"*Resolved*, That, in the opinion of the Suffolk District Medical Society, the history of the late epidemic of small-pox in Boston, and also the history of the disease for the last fifty years, show satisfactorily that the means for its prevention as now in force are insufficient for the purpose.

"*Resolved*, That the present measures for enforcing the general practice of vaccination and revaccination in the city, and more especially in the interior of the State, do not seem to have been fully adequate for this purpose.

"*Resolved*, That the repeal of the provisions in the statutes by which patients with small-pox and varioloid were restricted from communication with others, has tended to increase the extension of the disease, and that this society are of opinion that isolation of persons infected with small-pox would, under humane and wise provisions, promote public health, and diminish mortality."

Since the date of these resolutions, however, small-pox, far from being brought under more thorough control, which we know *can* be effected by the existing means of prevention, continued during twelve years to spread through our community with ever-increasing fatality. From 1855 to 1864, which is the period to which the resolutions just quoted apply, small-pox caused 1.71 per cent. of all deaths. In the

succeeding decennial period (1865 to 1874) the percentage rose to 2.36! In the years 1872 and 1873 it was 9.11 and 5.54!

The following figures,[1] relating to countries in which vaccination is more or less compulsory, exhibits what *can* be accomplished in the way of prevention of small-pox, and also shows, by comparison, how unduly rife the disease is in Boston: —

	Deaths by Small-pox per 100 deaths.		Deaths by Small-pox per 100 deaths.
Westphalia	0.6	Bohemia	0.2
Saxony	0.83	Lombardy	0.2
Rhenish Provinces	0.37	Venice	0.22
Pomerania	0.52	Sweden	0.27
Lower Austria	0.6	Bavaria	0.4

In Paris, from 1842 to 1851, deaths by small-pox were 1.05 per cent. of all deaths. In Berlin, from 1832 to 1850, the percentage was 0.55.

The year 1871 is memorable in England for an epidemic of small-pox, which ravaged several parts of the kingdom in a way of which there has been no example since 1838. During the twelvemonth, deaths by small-pox were 4.49 per cent. of all deaths, which is less than half the percentage reached in Boston in 1872. In London, in 1871, the percentage was 5.12.

During the ten years from 1862 to 1871 small-pox caused in England 1.11 per cent. of all deaths. The last decennial percentage in Boston was 2.36.

All these figures go to prove that our mortality from small-pox has, until recently, been very considerably in excess of that which prevails in other localities, where the means

[1] From the report of the Committee of the Epidemiological Society, quoted in Dr. J. C. White's paper on Vaccination, p. 41.

of prevention (namely, vaccination, and revaccination, and isolation) are more strenuously enforced, and that the warning conveyed in the epidemic of 1859–1860, though heard and understood, remained many years unheeded.

Knowing the ages of decedents by small-pox in 1872, we can determine the ages at which the protection afforded by vaccination, as at present carried out in Boston, has proved insufficient. The following table contains two columns, the one showing the percentages of decedents at selected ages, the other showing the percentages of inhabitants living at the same ages to the aggregate population :[1] —

Ages.	Percentage on all deaths by Small-pox.	Percentage on aggregate population.
Under 5 years	26.5	12.5
5 to 15	5.8	18.5
15 to 20	11.3	9.6
20 to 30	36.0	24.6
30 to 40	12.4	16.8
Over 40	7.9	17.9

We here see that children until five, although constituting only 12.5 per cent. of the population, contribute 26.5 per cent. of all deaths by small-pox;[2] while youths between 5 and 15, making 18.5 per cent. of the living, contribute only 5.8 per cent. of the decedents. The contrast between these two sets of figures is very striking, and shows, in the

[1] These percentages of population are calculated from the returns of the census of 1855; the population of that year is more likely to resemble that of the present time in age-distribution, than that of 1865, which was strongly affected by the recent war.

[2] Throughout the State, and during three years (1871–1873), of all deaths by small-pox, as many as 27.7 per cent. occurred under five years. (32d Registration Report of Mass., page 69.)

most peremptory manner, the deficiency of protection in the first years of life, and the efficacy of vaccination practised later on, at the ages of school attendance. The relative degree of exemption enjoyed during adolescence, and resulting from the postponed vaccination, undergone in obedience to the requirements of school-attendance, is seen to disappear gradually, so that we find again, between the ages of 20 and 30, a marked liability to fatal small-pox, which can bear but one interpretation; we here see evidence of an insufficient practice of *revaccination*, which measure of prevention is shown to become necessary within a space of 8, 10, or 12 years after the first vaccination, usually undergone in childhood. Later in life, at ages from 30 to 40, and upwards, the liability to small-pox is known to diminish considerably, independently of preventive measures; and figures show this to have been the case in Boston.

We have seen that small-pox until 1873 continued to be unduly prevalent in Boston, the recent epidemic of 1872–1873 having been the most fatal that has occurred since the introduction of vaccination. Now, inasmuch as it is an established fact that this disease is thoroughly subject to control by measures of prevention, it can be asserted that the excessive prevalence of small-pox in Boston has been due to the neglect of these measures, and gives the measure of such neglect.

Our conclusions are, with regard to the present time, that *isolation*, as provided for by the law of 1872, and as now enforced by the Board of Health, has produced beneficial results which appear very encouraging for the future, but that an examination into the ages at which people die of small-pox in Boston shows that *vaccination* is not practised early enough in infancy, and that *revaccination* is insufficiently resorted to in adolescence and early adult life.

Scarlet Fever.

The deaths by this disease during twenty-six years (1849 to 1874) were as follows: —

Years.	Deaths.	Years.	Deaths.	Years.	Deaths.
1849	317	1858	139	1867	306
1850	69	1859	142	1868	266
1851	50	1860	. . .	1869	330
1852	269	1861	155	1870	205
1853	229	1862	236	1871	111
1854	65	1863	130	1872	258
1855	74	1864	225	1873	474
1856	362	1865	50	1874	269
1857	403	1866	60		

During the entire period of twenty-six years (1860 omitted) scarlet fever has caused a total of 5,194 deaths, which is *more than double the mortality due to small-pox during the same period.* During the last ten years (1865 to 1874) deaths by scarlet fever have amounted to 3.31 per cent. of all deaths; the highest percentages during the ten years were those of 1867, when the ratio of deaths by this disease was 6.96 per cent.; of 1869, when it was 5.97 per cent.; and of 1873, when it was 6.0 per cent.

We see, moreover, that the course pursued by this disease throughout our community, year after year, differs very much from that of small-pox. Not only is the mean number of yearly deaths much greater, but the disease is much more uniform in its degree of prevalence; indeed, it is so unremittingly present, year after year, as to deserve the name of an *endemic* disease. Only in the years 1850 and 1851, 1854 and 1855, 1865 and 1866, has the number of

yearly deaths fallen below a hundred; and even in these years the deaths by scarlet fever were still so numerous that the comparative remissions are hardly sufficiently marked to constitute intervals between successive epidemics.

The following table shows the distribution of deaths by scarlet fever in the years 1872, 1873 and 1874 throughout the city, divided into wards:—

Wards.	Scarlet Fever.		Wards.	Scarlet Fever.
	1872.	1873.		1874.
1	20	22	1	13
2	13	89	2	13
3	8	19	3	11
4	8	10	4	3
5	11	12	5	8
6	9	20	6	4
7	65	68	7	51
8	5	10	8	5
9	17	11	9	1
10	10	17	10	7
11	6	15	11	8
12	30	73	12	26
13	9	13	13	19
14	11	23	14	7
15	21	54	15	22
16	7	10	16	5
			17	8
Public Institutions	8	19	19	7
			20	10
Total	258	474	21	20
			22	9
			Public Institutions	12
			Total	269

The distribution of scarlet fever by wards recalls that of small-pox. Certain wards yield a disproportionably large number of deaths, showing the existence of local influences which intensify the infectious power of the disease. In 1872, of all the deaths by scarlet fever which occurred outside of public institutions, as many as 43.2 per cent. took place in Wards 2, 7 and 12; in 1873 these three wards yielded 52.7 per cent. of all the fatal cases. In 1872 Ward 7 alone had over a quarter of all the deaths by scarlet fever, and in 1874 one-fifth. In 1873 the deaths in Ward 7 were exceeded by those in Wards 2 and 12.

As regards the ages * of decedents by scarlet fever, we find that in 1873, out of a total of 474 deaths, 338, making 69 per cent., took place under five years of age, and 440 under ten. From these figures, as well as from facts observed elsewhere, it is evident that scarlet fever is especially prevalent in the earlier years of life; it therefore plays an important part in the production of our excessive infant mortality.

Of the nationality of decedents by this disease in Boston, we know nothing, except the fact that it prevails, with the greatest intensity, in the wards which contain the largest proportion of foreign-born inhabitants. We know, however, from Gen. Walker's tables (see table on page 65), that the Irish are comparatively exempt from this disease, as well as from the other eruptive fevers, while the English and Welsh, the Swedes, Norwegians and Danes are extremely liable to it.

The determining cause of scarlet fever is in every case undoubtedly *contagion*, immediate or mediate. But be-

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* Murchison's statistics of 148,829 deaths from scarlet fever in England and Wales in 1847, and from 1855 to 1861, show that 63.07 per cent. of the deaths occurred under five years; 89.8 per cent. under ten years, and 95 63 per cent. under fifteen years of age. (From L. Thomas on Scarlatina. — Ziemssen's Cyclopædia, New York, 1875, Vol. II., p. 178.)

In New York, in 1872, out of 990 decedents by scarlet fever, 918 were under ten years of age.

sides the part played by the specific virus which conveys the disease from the infected to the predisposed person, other conditions exist which modify the intensity of the disease in different individuals, in different localities, and at different times,— conditions which probably exert their influence by increasing the predisposition to a severe form of disease in the recipient of infection, rather than by any modification of the virus itself. Of these conditions, however, our knowledge is very vague. It has been remarked that the disease prevails most extensively, and assumes the most fatal form, in localities inhabited by the poor, as certainly seems to be the case in Boston. Some authorities are inclined to believe that local conditions of soil, of drainage, or of water-supply, such as prevail in poor and crowded districts, and are the origin of what have been called by the expressive name of "filth diseases," may be, to a certain extent, accessory causes of the endemic character and of the exceptional severity of scarlet fever in particular localities.[1]

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[1] John Simon, speaking of the eruptive fevers, says: "Other influences, essentially connected with poverty, will tend to make all these diseases more fatal in places which are thronged with a poor laboring population; and possibly there exist in respect of each disease (especially in respect of scarlatina) certain conditions of local climate, unexamined conditions of soil and water-supply, for instance, which may not be indifferent to the result. But these matters are hitherto uninvestigated; and I do not feel justified in saying more than that they seem to me well deserving of investigation. For the wide range of local death-rates from measles, whooping-cough and scarlatina, among districts where all the populations have undoubtedly had abundant means of becoming infected, leads to the conclusion that local influences of one kind or another must have been greatly concerned in determining the proportionate fatality." (Introductory Report by the medical officer of the General Board of Health, London, 1858, page xxix.)

The same author, writing upon "Filth-diseases and their Prevention," comprises among such diseases certain diarrhœas, enteric fever, Asiatic cholera, dysentery, and perhaps scarlet fever. (Reports of the Medical Officer of the Privy Council, etc., new series, Vol. II., also in the Practitioner, June, 1875.)

On the other hand, Louis Thomas says that "it has been found that improvements in privies and sewerage in houses have no influence on the spread of scarlatina." (Ziemssen's Cyclopædia, New York, 1875, Vol. II., page 193.)

If these views be correct, there is reason to hope that sanitary measures directed against the more manifestly filth-begotten diseases, such as the diarrhœas and typhoid fever, especially such measures as aim at the purification of air and water, by means of improved sewerage, may also act favorably upon scarlet fever, and diminish the prevalence and severity of this very fatal disease.*

The only means of *prevention* applicable to this disease are *isolation* of the diseased persons, and *disinfection* of all possible vehicles of mediate infection. The patients should be kept in seclusion *until desquamation is ended*, and should then be carefully washed and attired in fresh, clean clothes, before being allowed to mingle unrestrictedly with other members of the community. The sick-room should, if possible, be repapered and painted, and thoroughly disinfected. All clothing, bedding, etc., used during sickness, should be destroyed, or disinfected, as is recommended in connection with small-pox.

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* Scarlatina has been distinctly observed to accompany enteric fever in its distribution throughout communities, and the inference has been drawn that similar channels may convey the virus of both diseases. It has been suspected that sewage may sometimes be the nidus of the contagion, and contaminated drinking water the vehicle of infection of scarlatina, as well as of typhoid fever.

The latest epidemic of scarlet fever in London was shorter in duration and far less severe than the preceding one; and the diminution of fatality of this disease coincided with a great decline of the prevalence and fatality of typhus and typhoid fevers. (Lancet, April 3, 1875, page 486.)

Measles.

Table showing the deaths by this disease from 1849 to 1874: —

Years.	Deaths.	Years.	Deaths.	Years.	Deaths.
1849	209	1858	80	1867	31
1850	75	1859	15	1868	68
1851	145	1860	. . .	1869	17
1852	29	1861	10	1870	42
1853	144	1862	68	1871	9
1854	136	1863	7	1872	60
1855	69	1864	46	1873	16
1856	77	1865	15	1874	41
1857	6	1866	17		

From these figures it is evident that measles, though constantly and widely prevalent in Boston, yet affects so mild a type at the present time as to cause relatively very few deaths. All the fatal cases of this disease during the last ten years only amounted to 0.52 per cent. of our total mortality. In England, during ten years (1862 to 1871), deaths by measles were 1.97 per cent. of all deaths, thus considerably exceeding the deaths by small-pox, of which the corresponding percentage was 1.11.

Unless a considerable epidemic of measles should occur, like those of 1849, 1851, 1853–1854, this disease can hardly call for the attention of the health authorities in Boston.

Cerebro-spinal Meningitis.

Our knowledge of the causes and prevention of this disease is so slight as to induce us to give very little space to its consideration. The first records of death in Boston, under

this designation, appeared in the City Registrar's report for 1867, although the disease is known to have existed in New England for many years previously. Since then the mortality due to this cause has been as follows: —

Years.	Deaths.
1867	7
1868	8
1869	7
1870	5
1871	3
1872	60
1873	216
1874	35

In 1873, deaths by this disease amounted to 2.75 per cent. of our total mortality, making a considerable addition to the aggregate of deaths by the epidemic zymotics.

The disease prevailed most severely in the poorest and most crowded wards. Of all the deaths, in 1873, by cerebro-spinal meningitis, occurring outside of public institutions, 34.4 per cent. took place in Wards 1, 2 and 7.

With regard to the causes of this disease, it has been observed to be most rife in those localities whose general sanitary condition was least good, as evidenced by the undue prevalence of other diseases of the zymotic class. There seem, indeed, to be reasons for suspecting that, as is manifestly the case with several of the infective diseases, *filthiness* of air, water and soil, may be a more or less necessary condition for the evolution of the specific virus to which the disease owes its origin, and by which it spreads.* If this

* Dr. J. Baxter Upham, in a paper on "Cerebro-spinal Meningitis in Massachusetts," carefully reviews all the circumstances of the epidemic which seemed likely to give a clue to the etiology of the disease. He says: "Our conclusions

view be correct we may hope to be able to exert some control over the development and propagation of cerebro-spinal meningitis by means of sanitary measures tending to purify the air and water of the city.

Whooping-Cough.

This disease has caused 513 deaths in Boston, during the last ten years, which deaths only amount to 0.86 per cent. of our total mortality during that period. In 1869 and in 1874 the percentage of deaths by whooping-cough was as high as 1.38 per cent. These are comparatively low percentages, showing that this disease is far less fatal in Boston than in many other communities.*

The prevention of this disease, in its present degree of prevalence, can hardly be said to come within the province of public sanitation, except so far as all fatal infectious disease is controllable by general sanitary measures tending to improve the health of inhabitants, and increase their power of resisting disease and death.

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then, while they must be, in the main, negative as to the existence of any definite exciting cause, which, under all circumstances, will produce the disease, lead us to say with confidence that those communities, towns or cities, whose sanitary regulations are strictest and best observed will be most likely to escape." (Fifth Annual Report of the State Board of Health of Massachusetts, 1874, page 312.)

Von Ziemssen is much more explicit: "The external circumstances of life which favor the outbreak of epidemic meningitis are those bad hygienic conditions which furnish the soil for the deposit and further development of the morbific germ, viz.: poverty, insufficient nourishment, and damp, overcrowded, badly ventilated, unclean ground floors. The better class suffer little from the disease. The overcrowding of dwelling and sleeping rooms, and the consequent loading of the air with animal emanations, perhaps also the saturation of the soil with garbage and the products of its decomposition, appear to be as powerful agents in the germination of the contagion as they are in that of cholera." (Ziemssen's Cyclopædia, New York, 1875, Vol. II., page 695.)

* In England, during ten years (1862 to 1871), of all deaths, as many as 2.32 per cent. were due to whooping-cough; the deaths by this disease considerably exceeded those by measles, and were more than double those by small-pox.

Diphtheria and Croup.

During the last ten years (1865–74) deaths by diphtheria, (including croup *) have amounted in Boston to 0.607 per 1,000 living, making 2.48 per cent. of all deaths. This disease is therefore more fatal in Boston than small-pox, and nearly as fatal as typhoid fever. In England, during ten years (1862–71), the death-rate by the two diseases (separately registered) was 0.42, the percentage being 1.90. The maximum percentage in Boston was attained in 1868, when deaths by diphtheria amounted to 3.51 per cent. of all deaths; the minimum percentage was that of 1872, namely, 1.16.

The ages of the decedents are not stated in the registration reports of the city. We know, however, that death by croup is almost exclusively limited to childhood; with regard to diphtheria, on the other hand, of all fatal cases occurring in England during seventeen years (1855–71) over half, namely 54.1 per cent., took place under five years of age. It is therefore evident that the diseases now under consideration cause no inconsiderable portion of our yearly infant mortality.

With regard to its causes we believe that diphtheria is a "miasmatic contagious disease" (Ertel), transmissible by contagion, both directly and indirectly; but of the conditions of its general prevalence at certain times and in certain localities we know little or nothing. Unfavorable conditions of soil (low and damp sites) and of sewerage have been incriminated, but the testimony in this direction is not unequivocal. Neither in Boston nor in England do

* We have preferred to group together all the cases returned under these two designations. Even those who do not believe that croup is but a diphtheritic laryngitis, will admit that the distinction between croup and diphtheria must often be so difficult as to render the registration of such cases under separate headings untrustworthy.

we find, upon examination of the mortality records for a number of years back, that the yearly mortality by diphtheria bears any relation to the degree of prevalence of typhoid fever, of scarlet fever, or of the "zymotic" diseases generally. Thus in Boston, in 1868, when the death-rate by diphtheria was at its highest point, 0.83 per 1,000, the rate by the eight principal zymotics was 6.84. In 1872, on the other hand, the death-rate by diphtheria was only 0.35, the rate by the zymotics being as high as 9.71 per 1,000. It would seem, therefore, that the conditions which govern the spread of diphtheria are not absolutely the same as those which give rise to the other infective diseases.

In the absence of any definite knowledge of the causes which impart to this disease an endemic or epidemic character, no means of *public* prophylaxis can be suggested. We can only hope that the disease may become somewhat less prevalent and less fatal when sanitary improvements adopted in view of other diseases, whose causes are better understood, may have effected some purification of the air which we breathe.

Typhoid Fever.

During the last ten years (1865–74) deaths from typhoid fever * have amounted to 0.654 per 1,000 living, making 2.70 per cent of all deaths. During the ten years preceding, the mean death-rate by typhoid fever was 0.535. It would not, however, be quite correct to infer that this disease has grown more prevalent in Boston, for the increase of the mean rate during the last decennial period is almost entirely due to the high rates which prevailed during the two years

* Under this heading are comprised a small proportion of cases referred to typhus fever, to remittent fever, or simply to "fever." In many such cases the diagnosis was erroneous or doubtful, and as typhoid fever is by far the most common of the continued fevers in Boston, we have preferred to unite these doubtful cases under the common term used above.

1872 and 1873, when our general death-rate rose to almost unprecedented heights. If we leave out these two years of exceptional mortality, we see that the proportional amount of mortality due to typhoid fever has remained almost constantly the same during the last twenty-five years.

The greatest mortality by this disease since 1851 occurred in 1873, when the rate was 0.87 per 1,000, making 3.07 per cent. of all deaths. The minimum death-rate was that of 1862, namely, 0.4 per 1,000. As typhoid never disappears from our community it may be said to be endemic, and, being more fatal to life in Boston than either small-pox or diphtheria, it constitutes an important item in our yearly bills of mortality.

Previous to the introduction of Cochituate water in 1848, the mortality from typhoid fever was very much greater than it has been since that date.[1]

Comparing Boston with the rest of the State as regards the prevalence of typhoid fever, we find that the disease is much more rife in the generality of towns in Massachusetts than it is in this city. Especially is this the case in the smaller towns. Thus, in 147 towns of more than 2,000 inhabitants the mean death-rate by typhoid fever during ten years was 0.755 per 1,000; while in 184 towns of less than 2,000 inhabitants the mean decennial rate was 1.189 per 1,000.[2] These rates considerably exceed the mean decennial typhoid rate of Boston.

The *nationality* of decedents by typhoid fever is not made known in our registration reports.

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[1] See "An Inquiry into the Causes of Typhoid Fever as it occurs in Massachusetts," by Dr. George Derby. (Second Annual Report of the State Board of Health, 1871, page 126.)

[2] Ibid., page 118. "There can be no doubt that typhoid in Massachusetts is a disease of scattered communities rather than of crowded towns, of rural rather than of urban districts. In spite of the smaller mortality from all causes, typhoid is more destructive in the farming towns than in the manufacturing towns and the large cities."

With regard to *locality*, we find that certain wards constantly exceed their due proportion of deaths by this disease. In the years 1872 and 1873, when typhoid was unusually rife, five wards (namely Wards 1, 2, 7, 12 and 15), whose united populations in 1870 constituted 45.5 per cent. of the entire population of the city, yielded 57.5 per cent. of all the deaths by typhoid occurring in the two years outside of public institutions. In 1874 these same wards, containing, according to the census of 1875, only 26.5 per cent. of the total population, yielded 34.7 per cent. of all deaths by typhoid occurring outside of hospitals, etc.

The study of the etiology of typhoid fever raises two great questions. The first has reference to the *origination of the typhoid poison*, while the second comprises the conditions under which the disease is *transmitted* from an infected to a healthy subject.

Of the circumstances under which the disease originates we know nothing certain. We will only say that the question whether the disease may, under certain circumstances, be generated *de novo*, or is, on the other hand, always continuously propagated from previous cases of typhoid fever, must be considered as still *sub judice*.[1] A considerable weight of recent testimony,[2] and of opinion among those of authority on this subject, seems to encourage the belief that the disease is almost always, if not invariably, transmitted from some pre-existing case of typhoid in the manner now to be described.

If we know little of the origin of the disease, the conditions of its *transmission* are pretty well known; moreover, they

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[1] See an address on the etiology of enteric fever, read before the Clinical Society of London, by Sir William Jenner. (Lancet, Feb. 20th, 1875.)

[2] See reports on five distinct outbreaks of typhoid fever, investigated by Dr. Blaxall, Dr. Buchanan, Dr. Ballard, Mr. Netten Radcliffe and Mr. Power. (Reports of the medical officer of the Privy Council, etc., New Series, No. II. London, 1874.)

are quite within our control, so that the disease may be said to be almost wholly preventable.

The conditions under which the disease spreads, appear to be as follows: typhoid fever is an infectious disease, not directly contagious, but transmissible by means of a specific virus, which itself appears to be gradually developed in the diarrhœal discharges of a typhoid patient, and which may then be absorbed by either the respiratory or the alimentary mucous membrane of an exposed and predisposed subject, thereby producing the disease in the latter. The contagium exists in the dejections of the typhoid patient,[1] and appears

[1] This mode of transmission of certain specific diarrhœal diseases (cholera, typhoid fever, dysentery) was suggested by Dr. John Snow. In relation to typhoid fever, it has been powerfully urged by Dr. Wm. Budd from seventeen years ago, and is now fully accepted by many authorities, among whom we will mention Liebermeister. Since writing the above, Mr. Simon's report on "filth-diseases" has come to hand, and we cannot refrain from quoting the following remarks on "enteric fever and its relation to excremental infection." It is significant that in this connection he says absolutely nothing about the theory of the generation *de novo* of the typhoid poison. "Since the year 1849, when Dr. (now Sir William) Jenner made known his conclusive and masterly discrimination of this specific form of fever, successive studies have tended with singular uniformity to connect it in regard of its origin with nuisances of an excremental sort. In illustration of that fact in the natural history of enteric fever, I may refer to an abstract which I append, of the experience of the medical department during the four years 1870–3, in this particular branch of disease-production; and such illustrations might be multiplied to any desired extent. The experience is not only that privies and privy drainage, with their respective stinkings and soakings, and the pollutions of air and water which are thus produced, have in innumerable instances been the apparent causes of outbreaks of enteric fever, but further that they have seemed capable of doing this mischief in a doubly distinctive way; first, as though by some aptitude which other nuisances of organic decomposition, though perhaps equally offensive, have not seemed equally or nearly equally to possess; and, secondly, as though this specific property, so often attaching to them in addition to their common septic infectiousness, were not, even in them, a fixed property. The explanation of this experience, the explanation of the frequent but not invariable tendency of privy-nuisances to infect with enteric fever, has seemed to consist in the liability of such nuisances to carry with them, not invariably, but as frequent accidental adjuncts, the "specific" contagium of any prevailing bowel-infection; for presumably the privies of a population receive

to acquire its full active virulence and its infectious power, after the dejections have been discharged, and during a process of ripening, as it were, which is favored by the presence of putrefying organic matter. These conditions are known to be most thoroughly fulfilled when such dejections are poured into a drain, and are allowed to mingle with ordinary sewage.

The contagium, when so developed and ripened, reaches the exposed individual in two ways.* The poisonous matter,

(inter alia) the diarrhœal discharges of the sick, and it has long been a matter of fair pathological presumption that in any "specific" diarrhœa (such as eminently is enteric fever) every discharge from the bowels must teem with the contagium of the disease. Medical knowledge in support of this presumption has of late been rapidly growing more positive and precise; and at the moment of my present writing, I have the gratification of believing that under my Lords of the Council it has received an increase which may be of critical importance, in a discovery which seems to give us, for the first time, an ocular test of the contagium of enteric fever, — in the discovery, namely, of microscopic forms, apparently of the lowest vegetable life, multiplying to innumerable swarms in the intestinal tissues of the sick, penetrating, on the one hand, from the mucous surface into the general system of the patient, and contributing, on the other hand, with whatever infective power they represent, to the bowel-contents which have presently to pass forth from him. (Mr. Simon here alludes to Klein's recent researches.) Adverting then summarily, in an administrative point of view, to the present state of medical knowledge and opinion, as to the way in which enteric fever spreads its infection in this country, I would say that it is difficult to conceive, in regard to any causation of disease in a civilized community, any physical picture more loathsome than that which is here suggested; that apparently, of all the diseases which are attributable to filth, this, as an administrative scandal, may be proclaimed as the very type and quintessence; that, though sometimes by covert processes, which I shall hereafter explain, yet far oftener in the most glaring way, it apparently has an invariable source in that which of filth is the filthiest; that apparently its infection runs its course, as with successive inoculations from man to man, by instrumentality of the molecules of excrement which man's filthiness lets mingle in his air and food." (Reports of the medical officer of the Privy Council, etc., New Series, No. II., London, 1874, page 13.

* Opinions are divided as to the relative frequency of infection by these two vehicles, air and water. Buhl, Wagus, and Pettenkofer have shown that in Munich, where typhoid fever is exceedingly prevalent, there is no demonstrable connection of the disease with the water supply. They attribute the infection to the inhalation of emanations arising through the soil after the

suspended in the air and wafted to and fro with other noxious emanations (gases, vapors, and solid particles) from privy, soil pipe, drain or sewer, is *inhaled*, or else the same matter, diffused in liquid sewage, contaminates our drinking water or our food, and is *swallowed*.

As accessory facts, bearing upon the etiology of the disease, we will mention that the typhoid poison, like all virulent matter, can reproduce itself to an unlimited extent under favoring conditions (presence of decomposing organic matter), thereby vastly extending its power of contamination; that it is active in extremely small doses, and that it retains its specific infectiousness, its vitality, for a long time, probably for many months, outside the human body.[1] On the other hand, we have reason to believe that the poison can be deprived of its noxious properties in several ways, as by heat (temperature exceeding 212° Fahr.), and by certain chemical agencies such as are comprised among the true "disinfectants." With regard to the practical efficiency of chemical disinfectants, however, we have little certain knowledge.[2]

From the foregoing data relating to the etiology of the disease, effective *measures of prevention* can be deduced.

Typhoid fever being already endemic in Boston, measures designed to prevent the importation of the contagium from without, if applicable, would hardly be of avail. Cannot we try, however, to limit the spread of the disease

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subsidence of the ground-water to low levels. (Buhl, Zeitschrift für Biologie Bd. I., 1865. — M. von Pettenkofer, ibid., 1868, 1874.)

Liebermeister, on the other hand, does not accept Pettenkofer's interpretation of the facts observed in Munich; he admits that infection can be produced by the air we breathe, and by the water we drink, but he thinks that the infection from drinking-water can be more clearly proved than the infection from the air. (See Ziemssen's Cyclopædia, American translation, vol. I., page 57.)

[1] Liebermeister, loco citato, p. 54.

[2] See article on "Disinfectants," in the Practitioner, 1873, page 472.

so as to render it comparatively harmless, or even to annihilate the virus in our midst? Theoretically this is possible, and practically much could and should be done to diminish the amount of our yearly mortality so caused. As the disease is not contagious in the strict sense of the word (since the contagium resides not in the patient, but in his diarrhœal evacuations), the isolation of persons stricken with the disease is unnecessary. Our first line of defence against the spread of typhoid fever from a diseased individual consists in the proper treatment of the dejections which are held to contain the seeds of the disease. The second and by far the most efficacious protection consists in precautions against the penetration of the fully developed poison into our lungs and stomachs.

1st. The dejections should, if possible, be rendered harmless before being thrown into the privy, and so being allowed to mingle with sewage.* According to the views of Lieber-

* Speaking of the power of disinfectants, and of its limitations, Mr. Simon, in his recent admirable report on "Filth Diseases, and their Prevention," says: "As regards certain procedures on a small scale, we know that, with well-circumscribed matter to act upon, and with chemical action precisely adjusted to its task, we can absolutely kill any given contagium. Taking, for instance, a bit of glass, which has on it a charge of vaccine or variolous matter, we know that if we *sufficiently* heat it in the flame of a lamp, or *sufficiently* treat it with certain strong officinal chemicals, which act in a like manner, we annihilate the power of infection; and we know that in the sick-room, where lies a patient with any dangerous infectious disease, say diphtheria, small-pox, or enteric fever, we can to some extent imitate the above acts. Provided that real skill shall direct, and real conscientiousness shall execute, what has to be done, every tangible discharge which passes from the patient, every sheet, or towel, or handkerchief which any discharge from him has fouled, can be treated with heat or other disinfectant, in a way to give at least comparative security against any outward spreading of his infection. It is greatly to be hoped that with time and with progress of general education, the systematic doing of such acts as these will, in each sick-house, be considered an imperative duty of good citizenship, and may at last be so fully understood in that light, as to be made, as far as practicable, an obligation at law; for disinfection in that sense (however remote we may be now from any sufficient adoption of it) would undoubtedly, if adopted, make chemistry an important

meister, if this could be universally done, sewer emanations would cease to convey typhoid fever, however noxious or unpleasant they might otherwise be.

2d. Our *water*, *food* and *air* must be guarded from becoming contaminated by such instalments of poison as may escape the first precautionary measures alluded to above. This end can be encompassed only by a supply of pure *drinking-water*, derived from healthy districts, and kept undefiled by sewage throughout its course from its highest sources till it is drawn off into our household vessels for use; and, secondly, by such arrangements of *privies*, *drains*, *and sewers*, as shall ensure the thorough and rapid removal of sewage from our houses and streets, and thereby prevent all contamination of the air we breathe within and without our homes.[1]

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ally to cleanliness in combating the filth-diseases of England; but such disinfection, the whole value of which is in its precision, differs diametrically from the pretended district-disinfections to which my text refers." (Public Health Reports, New Series, No II., page 25.)

As one example of the *modus operandi*, the following treatment of typhoid discharges has been recommended: "As a rule, I have a porcelain bed-pan used, the bottom of which is strewed, each time before being used, with a layer of sulphate of iron; immediately after a passage, crude muriatic acid is poured over the fæcal mass, as much as one-third or one-half of the bulk of the latter being used for that purpose. . . . . Any of the underclothing or bed-clothing that is soiled during stools should be immediately immersed in water, or in a solution of chloride of zinc, and should be thoroughly boiled within twenty-four hours." (Liebermeister, loco citato, page 195)

[1] Liebermeister states very plainly and tersely the object to be attained for the prevention of typhoid: "In general, we can say that the disposition of any locality to an epidemic of typhoid fever depends largely on the extent to which the inhabitants *breathe or drink the contents of their privies.* The greater the chances of this are, so much the greater are the probabilities that the introduction of an imported case of typhoid will produce an epidemic."

Mr. Simon, speaking of enteric fever and its relation to excremental infection, says that the disease spreads "as with successive inoculations from man to man, by instrumentality of the molecules of excrement which man's filthiness lets mingle in his air and food."

The drinking-water of Boston, Charlestown excepted, is derived from Lake Cochituate, Charlestown being supplied from Mystic pond. Judged by the somewhat unconclusive test of chemical analysis, the Cochituate water appears *as yet* to be sufficiently pure,[1] and by the additional test of sanitary experience it may also be considered to have been hitherto a satisfactory drinking-water. But we must not only satisfy ourselves that our water is at present sufficiently pure; we must watch jealously over the sources of our water-supply, and guard against the possibility of future

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[1] Cochituate water, analyzed in 1873 by Prof. Wm. R. Nichols, contained per 100,000 parts: —

Ammonia . . .	0.0033
Albuminoid ammonia .	0.0120

(Fifth State Board of Health Report of Mass., 1874, p. 127.)

The mean proportions of the same ingredients in ten specimens of "good drinking-water" of English towns (from tables in Wanklyn's work on Water-analysis) were as follows: —

Ammonia . . .	0.001 per 100,000 parts.
Albuminoid ammonia .	0.005 " " "

According to Wanklyn, "The filtered water supplied by water companies, no matter whether derived from a lake, from clean mountain streams, or from defiled rivers, yields from 0.05 to 0.10 parts of albuminoid ammonia per million; and indeed, if the filtration be efficient, approximates to 0.05." (Water Analysis, London, 1874, page 37.)

Dr. C. A. Cameron, analyst for the city of Dublin, says that the quantity of albuminoid ammonia which renders a water unusable is put down as 0.15 part per million parts of water. (Report on Public Health, Dub. Journ. Med. Sc., July, 1865, page 65.)

The mean proportion of chlorine in nineteen good drinking-waters (lakes and rivers) was 0.89 per 100,000 parts (calculated from figures given in Ed. Smith's work on "Foods," page 300). The Cochituate water contains of chlorine only 0.34 per 100,000 parts. The smallness of the proportion of chlorine in our water very much diminishes the significance of the comparatively large proportion of albuminoid ammonia (0.012 per 100,000 parts). When water contains large proportions of both albuminoid ammonia and chlorine, there is a strong presumption of contamination by sewage or animal matter. When the proportion of chlorine is relatively low, the albuminoid ammonia is probably derived from vegetable matter, and is of less serious import than when due to the presence of animal matter.

contamination. Prof. W. R. Nichols, writing, in 1874, upon this subject, expresses himself as follows: "If at the present time the water of Cochituate lake is well suited for all domestic uses, is there any well-grounded reason to fear for the future? Decidedly there is. The town of Natick, as stated in the last report of the Board, feels the necessity of a water-supply. Whether this supply be taken from Charles river or from the lake, the natural outlet for any system of drains or sewers is to the lake. . . . . It is from a very strong feeling of the danger of admitting sewage to any source of water-supply, that the hope is expressed that some measures will be devised for legally preventing such accessions. With the existing state of the law it seems impossible to obtain an injunction against such improper uses of a water-course or of a pond, unless it can be shown by actual proof that the water is rendered unfit for use. It would thus be necessary quietly to observe the gradual deterioration of the water, until actual sickness and death of water-takers make an injunction possible, and then the water would have been rendered almost hopelessly impure, and could hardly be brought back to its original state."[1]

The Mystic water, on the other hand, is much less pure, and its wholesomeness may certainly be questioned.[2]

But besides the water consumed in Boston *as drinking-water*, other water derived from much less pure sources does find its way down our throats, in a more or less disguised form, and may perhaps be the occasional vehicle of infection.

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[1] See report of the condition of certain rivers of Massachusetts, by Prof. W. R. Nichols, Fifth Annual State Board of Health Report, pages 123–125.

[2] The water of Mystic lake (at the gate-house) contained per 100,000 parts 0.008 of ammonia, 0.023 of albuminoid ammonia, and 2.6 of chlorine. (See "Report of the Medical Commission upon the Sanitary Qualities of the Sudbury, Mystic, Shawshine, and Charles river Waters;" Boston, 1874, table III., p. 54; see also an article on "The Present Condition of certain Rivers in Massachusetts, in the fifth report of the State Board of Health, 1874, p. 127.)

We allude to the adulteration of milk which takes place on quite a large scale and with little restraint.[1]

During the year 1874 the consumption of milk in this city amounted to over twelve and a half millions of gallons. The average amount of adulteration in the cases where an analysis was made (in consequence of suspicions based upon the appearance of the milk) was 19.38 per cent., the proportion of added water amounting to 32, to 33, and even to 40 per cent. in some of the poorest specimens of milk.[1]

From another source[2] we learn that of twelve specimens of milk, obtained from most respectable milkmen and grocers, sold as pure, and at the highest prices, there being in no case any previous reason to suspect adulteration, only two specimens were pure, the mean proportions of added water in the twelve cases being 13.3 per cent. If we assume the average amount of water fraudulently added to be but twelve per cent., and this is putting it at a low figure, we find that over a million and a half gallons of water were consumed in 1874 as milk, the price paid for this water amounting to nearly $500,000. Now, the greater part of this water is not Cochituate water; a certain proportion of it is Mystic water, added to the milk in Charlestown, and much of it is water derived from country wells and springs, added by the farmers, in agricultural districts where typhoid fever is known to be much more rife than it is in Boston. Recent investigations conducted in the most thorough and searching manner, by experts, having established the fact that epidemics of typhoid fever, and perhaps of other infective diseases, such as scarlatina, may be produced by in-

[1] See 16th annual report of the Inspector of Milk of Boston, page 42.

[2] See report on the adulteration of milk, by A. H. Nichols, M.D., assisted by Prof. J. F. Babcock. Fourth annual report of the State Board of Health of Massachusetts, 1873.

fected milk,[1] we cannot but view with some distrust this disguised importation into Boston of country well water, mingled with milk. Without wishing to exaggerate the dangers to be apprehended from this source, we desire to call attention to these facts, being of the opinion that if the State laws which prohibit and punish the sale of adulterated milk were more rigorously enforced than they have hitherto

[1] Mr. Simon, speaking of various epidemics caused by infected milk-supply, says: "I wish here to draw particular attention to the possibility, now well established, of filth infection being transmitted even on a large scale from district to district, in particular articles of food, and especially in the article of milk. In 1870 Dr. Ballard, now of this department, but who at that time was working with high character as officer of health for the parish of Islington, was able to show that an outbreak of enteric fever which had attacked, in ten weeks, 70 families and 175 persons in part of his district, coincided with the use of milk supplied from a particular dairy, where shortly before the outbreak there had been cases of enteric fever, and where apparently the infected house-drainage must have had easy access to an underground water-tank on the premises. There could be little reasonable doubt as to what in this epidemic had been the infectant; and since Dr. Ballard's connection with this department it has twice happened to him to be able very clearly to trace the same method of infection at work in considerable outbreaks of enteric fever, which he has been investigating; one in 1872 at Armley, in the borough of Leeds, the other in 1873, at Moseley and Balsall Heath, near Birmingham. A like case on a very large scale, and in some respects of unique interest, occurred also last year in London, chiefly in and about Marylebone, and was investigated elaborately by Mr. Netten Radcliffe, assisted in some stages of the inquiry by Mr. Power. A special interest of this case, as regards the point to which I have been adverting, is that here a great outbreak of enteric fever occurred at a distance of forty or fifty miles from the sanitary jurisdiction in which its true cause was contained; and the case is of the more value because the outbreak, as it happened to be in London, and happened also to have struck at its first blow in the houses of more than a dozen physicians and surgeons, had from the first its circumstances very attentively noticed by an unusual number of competent observers deeply interested in a right knowledge of them. I subjoin the instructive reports which relate to these three epidemics of enteric fever, respectively referable to supplies of milk. There is in each case reason to believe that the epidemic was due to excremental pollution of the dairyman's well, and it is solely in that point of view that I here insist on the cases. How the dairyman's water was enabled to spread its influence to his milk, and by what proportionate admixture it did so, are questions of little importance to my present subject-matter. The essential point is,

been [1] we should not only be supplied with purer and more nutritious milk, but we should probably also incur less risk of contracting infectious disease.

If for the present no positive fault can be found with our water-supply, the same cannot be said of our privies, drains and sewers. The existing endemic prevalence in Boston of typhoid fever, and of a variety of other infective diseases rec-

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that the water with which a dairyman washes his pails, and of which a very variable quantity may under varying circumstances remain in them, as an addition to his milk, is not likely to be of better quality than that which he and his sanitary authority consider good enough for his own drinking; and that, in regard of this, and many like possibilities of casual filth-infection, the general public are in intimate sanitary partnership with various of their purveyors of food." (J. Simon, Public Health Reports, New Series, No. II., page 23.)

Still another epidemic, traceable to a similar source of infection, took place at Brighouse, near Leeds. Here 68 cases of enteric fever occurred, in 65 of which, milk from the same dairy had been used. (See Lancet, Aug. 30, 1873.)

[1] "We have now nine or ten railroad milk-stations, which supply us with a large proportion of our milk, all of which are located within the limits of the city, with the exception of those at East Cambridge. To prevent the distribution of adulterated milk to our citizens, these milk-stations are often visited, and also the stables of the milkmen, not only in the city, but also in the neighboring towns. Nearly every day milk may be found in some of these milk-stations which has been either watered, or skimmed, previous to its leaving the dairy.

"Early in the season one of our large milk-dealers visited this office and informed the Inspector that two or three of his dairies, as he received them from the country, were badly adulterated, and that a number of times these dairies had been returned, and the parties notified as to their quality. As this milk was daily distributed to our citizens, I feel it my duty, if possible, in these cases, to commence at the fountain-head of the adulteration.

"To this end, your Inspector, with the usual milk-collector, visited the adulterated milk places, in one of which six large cans of milk were found, ready for the market; at the other place four cans were awaiting removal by the collector. The ten cans of milk were taken to the country milk-station and examined, and were found extended by the addition of water. One sample of each of these dairies was brought to the city, and analyzed by the city chemist. The first sample was found to contain added water, in one hundred parts, 25.50, and the other, 32.80.

ognizing analogous causes, namely, the infection of the system by putrefying organic matter, or more plainly, by "filth" of various kinds, simple and specific, is sufficient evidence of the impurity of the air which many of us breathe. Fortunately the subject of the future drainage and sewerage of Boston is now in the hands of a competent commission, from which we may expect the best possible solution of this most important, complex and difficult question.

The value of property constructed sewers as means of sanitation is illustrated by the facts exhibited in the following table,[1] which shows the general death-rates which prevailed in twelve English towns before and after the completion of sanitary works, together with the reduction of the mortality by typhoid fever and phthisis which ensued.

"These cases were carefully prepared, and brought to the notice of the courts in the counties to which they belonged. In one case the offender was convicted, *and fined five dollars* and costs; and in the other case, notwithstanding the positive evidence of guilt laid before the grand jury, they refused to find a bill of indictment." (See 16th Annual Report of the Inspector of Milk, 1875, page 10.)

In this connection, we wish to call attention to the law by which such offences may be punished. "Inspection of milk: An Act to prevent the sale or exchange of adulterated milk. Section 3. Whoever knowingly sells, or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, adulterated milk, or milk to which water or any foreign substance has been added, shall for the first offence be punished by a fine of not less than fifty, nor more than three hundred dollars, and for any subsequent offence by a fine of not less than one hundred dollars, and imprisonment in the House of Correction not less than thirty, nor more than ninety days."

[1] From a work on "Sanitary Engineering," by Baldwin Latham, London, 1873, page 10.

Towns.	Death rate before Construction of Works.	Death rate after Construction of Works.	Reduction of Typhoid Fever per cent.	Reduction of Phthisis per cent.
Banbury	23.4	20.5	48	41
Cardiff	33.2	22.6	40	17
Croydon	23.7	18.6	63	17
Dover	22.6	20.9	36	20
Ely	23.9	20.5	56	47
Leicester	26.4	25.2	48	32
Macclesfield	29.8	23.7	48	31
Merthyr	33.2	26.2	60	11
Newport	31.8	21.6	36	32
Rugby	19.1	18.6	10	43
Salisbury	27.5	21.9	75	49
Warwick	22.7	21.0	52	19

The mean death-rate of these twelve towns was lowered from 25.6 to 21.7 per 1,000, and the average mortality by typhoid fever was diminished to about one half of what it was before the completion of the new sanitary works. The mean death-rate of Croydon during seven years before the construction of the new sewers was 23.66 per 1,000; the mean rate during thirteen years afterwards has been only 18.64.

Upon the subject of the best disposal of our sewage, we shall not attempt to offer any suggestions. We wish only to state that our investigations into the nature and the causes of fatal disease in Boston have convinced us of the urgent necessity of providing the city with a more satisfactory system of sewers than we now possess. In spite of a supply of apparently pure drinking-water, typhoid fever continues to be endemic, the deaths caused by this eminently preventable disease amounting to 2.70 per cent. of all deaths. This cir-

cumstance alone would suffice to demonstrate the inadequate removal of sewage from our midst, in consequence of which the air which we breathe is contaminated by the foul and poisonous emanations which arise from stagnating filth of every kind. The dissemination of the specific poison of typhoid fever is by no means the only punishment which we are incurring; other diseases, much more murderous, acknowledge an analogous origin, as we shall see further on when discussing the causes of diarrhœal diseases, of infant mortality, and of the various "filth diseases" in general. In the excessive prevalence in Boston of these diseases, especially of the very fatal diarrhœal diseases of infancy, we shall find additional and yet more forcible arguments in favor of the improvement of our sewerage than are afforded by the foregoing facts relating to typhoid fever. Our final conclusion on this subject, if we may be allowed to state it now, will be that no measures of sanitary improvement are more strenuously needed, or are more likely to repay the cost, however great it may be, than the construction of a system of sewers adapted to our present and future needs.

Diarrhœal Diseases.

In this group are, by necessity, comprehended a heterogeneous variety of fatal cases, reported and registered under the following designations: *cholera infantum*, *dysentery*, *cholera-morbus*, and often, more simply, *diarrhœa*, or *bowel-disease*. There are several reasons why it is customary among sanitary statists to assemble together in one group, diseases so dissimilar. In the first place, a distinctive diagnosis is often very difficult, and, when attempted, of doubtful accuracy, especially in the case of infants and young children who supply three-quarters of the deaths by inflammatory affections of the bowels; often, indeed, in such cases, no attempt at diagnosis is made beyond the recognition of the leading symptom, under the name of which the case is

registered. In the next place, these diseases have this characteristic in common, that in the majority of *fatal* cases, which, we repeat, occur among infants, they recognize one and the same cause, namely, the simple, unspecific infection of the system by filth. This proposition we shall substantiate further on, in connection with the subject of infant-mortality. In a certain small proportion of the deaths occasioned by diarrhœal diseases, no infection, even by unspecific putridities, can be invoked as a cause. Sporadic cases of simple or catarrhal dysentery,[1] such as are observed in our community, cases of cholera-morbus, and, indeed, the majority of cases of diarrhœal disease occurring among adults, are certainly not due to any infection, but generally to some simple local irritation of the intestinal mucous membrane. Even among young children such agencies must be the occasional cause of diarrhœal disease. Such cases, however, represent but a small proportion of the *fatal* diarrhœa of which we speak, which is mainly infantile, and of an *infective* (not infectious) origin.

The "diarrhœal diseases" are exceedingly rife in Boston, one-eighth of all deaths during the last ten years having been so caused. The greater part of this mortality consists of cases of *cholera-infantum*, which disease has caused one twelfth (8.02 per cent.) of all deaths during the last ten years. As we propose to consider by itself, further on, the subject of infant mortality, in which diarrhœal diseases play so important a part, we shall not dwell at any length upon these diseases in general. We wish now only to adduce their exceeding prevalence as a further proof of the urgent necessity for sanitary measures tending to secure the more effectual removal of the filth in which a large proportion of our population lives. The following quotation from one of

[1] Epidemic dysentery, which rarely or never occurs in our community, is an infectious disease, of which the specific contagium exists in the dysenteric bowel discharges.

the leading authorities on sanitary questions, sets forth the etiology of diarrhœal diseases in very plain language: "Nothing in medicine," says Simon, "is more certain than the general meaning of high diarrhœal death-rates. The mucous membrane of the intestinal canal is the excreting surface to which nature directs all the accidental putridities which enter us. Whether they have been breathed, or drunk, or eaten, or sucked up into the blood from the surface of foul sores, or directly injected into blood-vessels by the physiological experimenter, there it is that they settle and act. As wine 'gets into the head' so these agents get into the bowels. There, as their universal result, they tend to produce diarrhœa; — simple diarrhœa, in the absence of specific infections; specific diarrhœa, when the ferments of cholera and typhoid fever are in operation. And any such distribution of diarrhœal diseases as has just been noticed, warrants a presumption — indeed, so far as I know, a practical certainty — that *in the districts which suffer the high diarrhœal death-rates, the population either breathes or drinks a large amount of putrefying animal refuse.*"[1]

A few comparisons will suffice to show how excessively high is our mortality by diarrhœal diseases. During the last ten years, and in the absence of any epidemic of cholera, our mean diarrhœal death-rate has been as high as 3.03 per 1,000 living. That of London during seven years (1848–1854), including the epidemic of cholera of 1853–54, was only 2.81 per 1,000, and if we deduct the cholera-rate (1.63) the diarrhœal rate sinks to 1.18 per 1,000. Turning to Liverpool, then about the most unhealthy town in England, we learn that there the diarrhœal death-rate during the same period (deaths by cholera being deducted) was 3.05 per

[1] General Board of Health. Papers relating to the sanitary state of the people of England. Introductory Report by the Medical Officer of the Board, London, 1858, page xi.

1,000.[1] The excessive prevalence of the diarrhœal diseases in Boston is very manifest. We shall see further on, that infective diarrhœa is particularly rife among infants, and that it constitutes the greater part of our excessive infant mortality.

II. Consumption.

Consumption or phthisis is by far the most fatal of all the diseases which shorten the lives of the inhabitants of this country. At the same time it is a disease of which the causes are, to a very considerable extent, undeniably subject to control and removable by measures belonging to both public and private hygiene. "There is a further reason for which the mortality by phthisis ought to be very jealously criticised, — a reason, for which its local differences of pressure deserve quite peculiarly to be regarded as a matter of national concern. The tendency to tubercular disease is one which transmits itself from parent to child; and thus if in any one generation the disease be artificially engendered or increased, that misfortune does not confine its consequences to the generation which first suffers them. *Whatever tends to increase tubercular disease among the adult members of a population must be regarded as assuredly tending to produce a progressive degeneration of race.*"[2]

Deaths due to consumption have amounted in Boston during the last ten years (1865–1874) to 16.80 per cent. of all deaths, at the mean rate of 4.12 deaths by phthisis to every 1,000 living. During the ten years from 1850 to 1859,

[1] These figures are borrowed from a paper on "The different prevalence of certain diseases in different districts in England and Wales," by E. Headlam Greenhow. (Papers of the General Board of Health, London, 1858, page 88.)

[2] J. Simon. Reports to General Board of Health, London, 1858. Introductory Report, page xi.

deaths by phthisis were 18.07 per cent. of all deaths, the mean death-rate being 4.60 per 1,000.

The yearly death-rates by phthisis, in the years of the census, were as follows: —

1850 = 4.28 per 1,000
1855 = 4.57 " "
1865 = 4.22 " "
1870 = 3.95 " "

In the State of Massachusetts the mean decennial death-rate by phthisis from 1854 to 1863 was 3.86, while from 1864 to 1873 it was 3.46.

These figures show that during the last twenty-five years the mortality by consumption has undergone a slight gradual diminution in Boston, as well as throughout the State.

Let us now compare these rates with those observed in England. We learn from the figures published in the reports of the Registrar General that the mean decennial death-rate by phthisis (1860–69), throughout England and Wales, was 2.54 per 1,000 living. The phthisis rate varied according to locality in different registration districts from 1.34 to 3.90 and 4.45 per 1,000.[1] In London, in 1871, it was 2.67 per 1,000.

These figures show that throughout the State of Massachusetts the mean death-rate by phthisis is excessively high, and that in Boston it reaches and sometimes even exceeds the maximum death-rate observed in those districts of England in which the liability to this disease is greatest.

Turning to the *nationality* of decedents by consumption, we find that during ten years (1864–73), of all the deaths by phthisis which have occurred in Boston, numbering 9,493, as

[1] J. Simon. Reports to General Board of Health. Introductory report, page xxiii.

many as 4,881, or 51.37 per cent., have taken place among our foreign-born inhabitants. These, by the census of 1870, constitute only 35.12 per cent. of our population. The great discrepancy of these ratios is due to two circumstances, namely, to the greater inherent liability of foreigners to phthisis, and, secondly, to the fact that our foreign population is largely composed of adults at ages when phthisis is most common.

The distribution of deaths by phthisis among the various races which constitute our foreign population is exhibited in the following table, which shows for ten years the numbers and percentages of decedents belonging to each of the leading foreign races, and which also shows collaterally, for comparison, the ratios per cent. of each foreign race to our aggregate foreign population.

Birthplaces.	Decedents by Phthisis during ten years. (1864-73.)	Percentage to all Foreign Decedents by Phthisis during ten years.	Percentage of each race to total Foreign Population. 1870.
Ireland	3,664	75.08	64.65
England and Wales	221	4.52	6.90
British American Provinces	563	11.53	15.39
Germany and N. Europe	227	4.65	7.64
Scotland	70	1.43	2.03
Other Foreign Countries	136	2.78	3.39

We here see clearly exhibited the great, we may say the extraordinary, liability to phthisis which characterizes the Irish people as compared with the other races which dwell beside them under similar conditions in this country.[1] This

[1] The vital statistics of other cities yield similar results. In 1870 the foreign population of New York comprised 48.2 per cent. of Irish, and 36.0 per cent. of Germans, the other foreigners being 15.8 per cent. Of all foreign decedents

great liability to phthisis, already observed by others, and specially noted by Gen. Walker among the results accruing from the study of the last National Census, strikes us as a most remarkable feature of our sanitary statistics. Nationality exerting such a powerful influence in the production of this, the most prevalent and fatal of all diseases, becomes a preponderating etiological factor, which must be kept constantly in view throughout any attempt to determine the conditions under which phthisis is developed among the people of this community. At the same time, such is the complexity of this interesting etiological problem, that it is well-nigh impossible for us to form even an approximative estimate of the amount of influence exerted by nationality in the development of phthisis. Our foreign populations, particularly the Irish inhabitants, live under conditions which combine together and intensify all the recognized causes, predisposing and determining, which favor the origination and the increase of tubercular disease. Were it not that inheritance is known to play so important a part in transmitting the predisposition to consumption, the question might even be raised whether circumstances connected with social condition, habits of hygiene, and locality of residence, would not alone suffice to explain the liability of the Irish to the disease which is now under consideration. These remarks will find their application in connection with the following facts relating to local variations in the death-rate by phthisis.

The *localities* in which phthisis finds the greatest number of victims in Boston are exhibited in the following tables, which show the death-rate of each ward by this disease in the

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by phthisis the Irish contributed 63.3 per cent., the Germans 24.8 per cent., and the other foreigners 11.8 per cent.

We know, moreover, by the figures published in the U. S. census of 1870, that the Irish inhabitants of the United States, while constituting 33.3 per cent. of our total foreign population, contributed 47.8 per cent. of all foreign decedents by phthisis.

census years 1865 and 1870. In each table the wards are arranged in such an order that their phthisis-rates form an increasing series, beginning in each series with the ward in which the mortality by consumption was least. At the same time, lest these tables might be misunderstood, by conveying the erroneous impression that the variations in mortality were entirely dependent upon local differences of the topographical conditions which characterize the various sites, we have appended collateral columns showing the percentage of foreigners (1870) or of Irish (1865) inhabiting each ward. We shall presently have occasion to consider the connections which may exist between the two sets of figures here exhibited side by side.

Boston, 1865.				Boston, 1870.			
Wards.	Death-rate by Phthisis per 1,000.	Percentage of Irish inhabitants.	Mean Percentages of Irish.	Wards.	Death-rate by Phthisis per 1,000.	Percentage of Foreign Inhabitants.	Mean Percentages of Foreigners.
6	1.82	15.2	17.8	16	1.8	23.5	27.5
4	2.13	23.6		14	2.2	27.4	
9	2.91	16.9		12	2.8	29.4	
11	3.21	15.6		9	2.9	29.8	
10	3.22	23.7	26.3	1	3.0	33.6	28.4
2	3.31	17.5		11	3.2	23.6	
8	3.65	29.7		6	3.4	26.0	
3	4.34	34.2		8	3.4	30.6	
5	4.61	15.0	29.1	15	3.5	41.9	33.8
1	4.80	32.8		10	3.6	27.9	
12	4.94	25.6		13	3.6	38.7	
7	6.09	42.9		2	4.0	46.9	
				3	4.2	33.9	39.9
				5	4.2	43.8	
				4	4.9	33.9	
				7	5.2	48.0	

The several *causes* of phthisis, predisposing and determining, are quite well known, though their relative degrees of activity are not established. They are as follows: —

1st, Inheritance. — The constitutional disease, of which pulmonary tuberculosis is the principal manifestation, is transmissible from parents to offspring. This is an established fact requiring no demonstration.[1]

If *nationality* may constitute, as we have seen, an inborn predisposition to tubercular disease, this is but a collective manifestation of inheritance exemplified on a large scale. We have shown that the Irish race present such a predisposition in a very marked degree, as is partly evidenced by their great liability to consumption. We say *partly* evidenced, because deaths by consumption represent but a part of the entire mortality caused by the constitutional disease of which pulmonary tuberculosis is one of the most striking manifestations. Many cases registered under more or less orthodox names, as *tabes mesenterica*, *marasmus*, *debility*, *meningitis*, *hydrocephalus*, *disease of the brain*, etc., are probably cases of tuberculosis, affecting principally other organs than the lungs; while many other cases reported as *bronchitis*, *pneumonia*, *pleurisy*, *disease of the lungs*, etc., are cases of pulmonary tuberculosis in which diagnosis has been imperfect, and registration incorrect. Thus the phthisis-rate gives by no means the full measure of the amount of mortality due to the inherited constitutional taint which occasions the development of consumption. The distribution of these varied and often obscure forms of tuberculosis among our

[1] The relative frequency of *acquired* and *inherited* phthisis cannot be determined, and opinions on this point vary extremely. Louis believed that phthisis was of hereditary origin in only ten per cent. of all cases; Cotton, on the other hand, observing at the Brompton Hospital for consumptives, found 367 cases of inheritance in 1,000 cases of disease. Hérard and Cornil, having carefully investigated 100 cases, found 33 cases of hereditary disease; they estimate that about one-half of all cases of phthisis are inherited. (See Hérard et Cornil, De la phthisie pulmonaire, Paris, 1867, page 587.)

different nationalities, native or foreign, is not made known; but there is no reason to suppose that tubercular disease in these forms does not obey the same laws of inheritance as govern the liability to consumption; therefore those classes of our population which present a special liability to phthisis must also be correspondingly liable to the less clearly defined forms of tuberculosis to which we have just alluded.

Another consideration deserves here to be noted. We have spoken at some length of the prevalence of tubercular disease among our foreign-born inhabitants. Now, the tendency to this disease is transmitted by these foreign parents to their offspring; these, however, being registered as *natives*, a considerable proportion of the phthisis which is laid to the charge of our native population, and which we offset as "native" phthisis against the "foreign" phthisis, must really owe its origin to foreign-born inhabitants.* Unless the foregoing consideration be taken into account, we should fail to

* The following observations may perhaps throw some light upon the ulterior evolution of this imported hereditary tendency to tubercular disease, which cannot but be an important factor of our general sanitary condition: "As regards the age at which hereditary phthisis is developed in the successive generations of a family, Prof. Natalis Guillot thinks he has recognized as a fact that when a man becomes consumptive at sixty years of age, his children die before reaching the age of forty, and his grandchildren in infancy or childhood; in other words, he thinks that in each succeeding generation the manifestations of the inherited disease appear at earlier ages. This important fact has been verified by other observers." (Hérard and Cornil, loco citato, page 569.)

In this connection, and as showing that a certain relation probably exists between our excessive infant mortality and the prevalence of phthisis among certain classes of our population, we reproduce in juxtaposition the two following propositions laid down by Mr. Simon. He asserts that "whatever tends to increase tubercular disease among the adult members of a population must be regarded as assuredly tending to produce a progressive degeneration of race." He also says in another place that "it cannot be too distinctly recognized that a high local mortality of children must almost necessarily denote a high local prevalence of the causes which determine a degeneration of race."

appreciate the full import of the facts relating to the prevalence of tubercular disease in this community.

The influence of nationality upon the topographical distribution of phthisis in Boston is exhibited in the tables on page 126, showing the death-rates by phthisis of each ward in 1865 and in 1870, together with the corresponding percentages of foreign inhabitants. In 1865, of the twelve wards into which the city was then divided, six, containing a mean percentage of 18.7 Irish inhabitants, yielded a mean death-rate by phthisis of 2.9 per 1,000 living. The remaining six wards, with 30.0 per cent. of Irish, presented a phthisis-rate of 4.5 per 1,000. In 1870 the city comprised sixteen wards. Of these, eight, with 27.9 per cent. of foreign inhabitants, showed a mean phthisis-rate of 2.6 per 1,000, while the remaining eight wards, containing 39.3 per cent. of foreigners, yielded a phthisis-rate of 4.1 per 1,000. In each year, Ward 7, with the maximum percentage of foreign inhabitants, showed the highest death-rate by phthisis. These facts exemplify the influence exerted by inheritance upon the development of phthisis, an influence which finds its most striking expression in this instance of national liability to the disease.

2d, Contagion. — The opinion that phthisis can be transmitted otherwise than by inheritance, namely, as a consequence of prolonged and intimate cohabitation, such as takes place between man and wife, has long been entertained by observers of great weight.[1] Cases which have been reported in corroboration of this view are, however, of equivocal significance, and the question of the contagion of phthisis must be held to be still *sub judice*.

3d, Humidity. — This condition is firmly established as one of the chief agencies by which tubercular disease of the respiratory organs is developed and increased. It is now twenty-three years since Dr. H. I. Bowditch demonstrated the fact

[1] See De la Phthisie pulmonaire, Hérard et Cornil, Paris, 1867, page 560.

that "a residence on, or near, a damp soil, whether that dampness be inherent in the soil itself, or caused by percolation from adjacent ponds, rivers, meadows, marshes, or springy soils, is one of the primal causes of consumption in Massachusetts, probably in New England, and possibly in other parts of the world." He also asserted, and here is the most valuable outcome of his researches, that consumption could "be checked in its career, and possibly, nay, probably, prevented in some instances, by attention to this law."[1] This assertion, we might say, this prophecy, has been fully verified, as we shall be able to show, when speaking of the prevention of phthisis.

3d, Climate. — Besides wetness of soil, harshness of climate constitutes a potent, local cause of pulmonary phthisis, as well as of all inflammatory diseases of the respiratory organs. A climate characterized by an excessive range of temperature between the summer heat and the winter cold, by sudden, rapid and extreme changes of temperature at all seasons, and by violent and bleak winds, exerts a most pernicious influence upon those in whom the predisposition to tubercular disease exists. Such a climate is that of Massachusetts. We have here one of the principal causes of the great prevalence of phthisis in this part of the United States; but it is, of course, a cause against which no general measure of prevention can be suggested.

4th, Privation. — Every influence which tends to produce a general state of physical debilitation favors the develop-

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[1] Medical communications of the Mass. Med. Soc., Vol. X., No. II., 1862, page 67.

In 1868 Dr. Buchanan published a report (in Tenth Report of the Medical Offices of the Privy Council) on the Distribution of Phthisis as affected by dampness of soil, of which the main conclusion was that "wetness of soil is a cause of phthisis to the people living upon it." — Dr. Buchanan, when conducting his investigations, was ignorant of Dr. Bowditch's publications on this subject; the corroboration of Dr. Bowditch's views is thus rendered all the stronger.

ment and the increase of phthisis. All forms of privation, such as are incurred by man in consequence of poverty, ignorance or heedlessness, produce sooner or later a state of general impoverishment of the system, which often results in the development of tubercular disease. In the first rank of predisposing causes of this order, we find the privation of fresh air and of sunlight. To this cause is due in great part the excessive prevalence of phthisis in manufacturing towns, and in urban districts, where the inhabitants live in crowded, dark, and ill-ventilated lodging-houses. Dr. E. H. Greenhow's researches establish the proposition that "in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion, other things being equal, their respective death-rates by phthisis are increased."

The habitual privation of food in sufficient quantity and of proper quality is an obvious cause of physical impoverishment, whether such privation be due to an inadequate supply of food, or to dyspepsia, food being sufficient in quantity. This form of privation may result from genuine poverty, such as everywhere commands the sympathy of all charitable persons, or it may be due to artificial poverty, engendered by shiftlessness and ignorance, or by the misuse of means which would be amply sufficient if properly used. Viewed in this light, habits of intemperance occupy an important place among the causes which favor the development of tubercular disease among adults. The workingman's wages, when spent in great part for drink, prove insufficient for the maintenance of himself and his household; their food consequently is insufficient and poor in quality; the adult members of the family are weak and continually ready to break down; the infants are born feeble, and suffer for lack of mother's milk, or other suitable food. There is another more direct means by which alcoholic excesses favor the development of phthisis in the tippler or drunkard, namely, by consequence

of the dyspepsia which affects the majority of habitual inebriates, and incapacitates them from profiting by such food as they may have the means to procure.[1]

The *prevention of phthisis* is certainly feasible to a considerable extent, for, of all the causes reviewed above, some are undeniably removable. Inheritance and nationality must be suffered to exert their baleful influence without restraint; we can only look forward to the day when the growing preponderance of the native element of our population shall have gradually brought about a much desired improvement of our sanitary condition. Against climate also it is obvious that no measure of public hygiene can be of any avail. The other conditions are to a great extent amenable to prevention by sanitary measures.

First, as regards humidity. In no way have Dr. Bowditch's views of the dependence of consumption upon dampness of soil proved more fruitful, or received more convincing corroboration, than by the happy influence exerted by sanitary improvements, consisting in properly constructed drains and sewers, and tending to dry the soil of localities where phthisis was very prevalent. Dr. Buchanan found in his elaborate investigations on this subject, undertaken six years after Dr. Bowditch's researches, that "phthisis had been greatly reduced in towns where the water of the soil had been artificially removed, and that it had not been

[1] A form of consumption due to the abuse of alcohol has been recently described by Dr. B. Richardson (in the Cantor lectures on alcohol, at the Society of Arts, London), under the name of "Alcoholic Phthisis." It is observed among male adults, aged from 28 to 55 years, who are addicted to the excessive use of liquor. According to this view, phthisis would be a direct result of the action of alcohol, being developed under the influence of this agent in a manner analogous to the production of cirrhosis of the liver under similar conditions. Until this interpretation of the facts is substantiated, we shall rather incline to the belief that habitual intemperance favors the development of consumption indirectly, through the gradual impoverishment of the system which it occasions.

reduced in other towns where the soil had not been dried."[1] We have already reproduced on page 118 a table borrowed from Mr. Baldwin Latham's work on Sanitary Engineering, showing the effects of sanitary works constructed in twelve English towns. The mean death-rate of these towns was reduced from 25.6 to 21.7 per 1,000; and the average reduction of the mortality by phthisis amounted to 30 per cent. The smallest reduction obtained in any one town was 11.0 per cent., and in several towns the reduction exceeded 40 per cent., in one instance (Ely) reaching 47 per cent.

Is there any reason why similar results should not be attainable in Boston? Let us suppose that the deaths by phthisis of last year, which were 1,333 in number, had been diminished by 30 per cent., in consequence of the construction of sanitary works like those which proved so strikingly beneficial in England: the lives saved in one year on the mortality by consumption alone would have amounted to 399, so many persons being rescued from a premature death by phthisis. Of the collateral diminution of deaths by the other forms of tuberculosis, as well as by the various filth-diseases (diarrhœas, typhoid, etc.), we say nothing for the present, as we are now considering only the prevention of consumption.

Privation in its various forms is less easily opposed by measures of public hygiene. Physical and mental disability, ignorance, shiftlessness, and often immorality, are the conditions which generally underlie poverty and pauperism, and unavoidably entail a certain degree of habitual privation of the necessaries of life. Habits of intemperance acknowledge similar causes. If a remedy exist for these failings it will be found in measures of an educational character which do not come within the province of sanitation, though all powerful for good in that direction.

[1] Tenth Report of the Medical Officer of the Privy Council, London, 1868, page 109.

III. Bronchitis and Pneumonia.

Under these two headings are comprised nearly all the cases in which the various inflammatory affections of the respiratory organs have been the cause of death. The mortality so occasioned has amounted during the last ten years to 8.82 per cent. of all deaths; 2.63 being due to bronchitis, and 6.19 per cent. to pneumonia.[1]

These affections are known to be particularly fatal at the extreme ages of life, among infants and young children, and among the very aged. They offer a special interest from the circumstance that they occasion a considerable proportion of our excessively high infant mortality. The ages of decedents by these affections in Boston are not published. We know, however, that in the State of Massachusetts nearly 40 per cent. of all fatal cases of pneumonia take place

[1] We find, on comparing our vital statistics with those relating to England, a remarkable difference as regards the relative degrees of frequency of bronchitis and pneumonia. Throughout England, deaths by bronchitis are more than twice as numerous as deaths by pneumonia. In Boston, and throughout Massachusetts, on the other hand, more than twice as many deaths are caused by pneumonia as by bronchitis. While in Boston, during ten years, bronchitis caused 2.6 per cent. of all deaths, in England in 1871, as many as 9.2 per cent. of all deaths were so caused, and in London, 11.2 per cent. Comparing also the ages at which pneumonia proves fatal in Massachusetts, and in England, we find a very great difference. In Massachusetts 38.4 per cent. of all deaths by pneumonia occur under five years of age, while in England the percentage of deaths under five, by this affection, is as high as 61.7 per cent. The cause of these differences is probably to be found in different habits of diagnosis; many cases which in England would be reported as cases of bronchitis (cases perhaps of capillary bronchitis?) must, with us, be considered as cases of pneumonia. This view seems the more likely, from the fact that with us the proportion of cases of pneumonia occurring during the first five years of life, namely, 40 per cent. of all cases, is very nearly the same as the percentage of cases of bronchitis occurring under five. Cases also of œdema of the lungs are probably often mistaken for pneumonia, and, being returned as such, swell the apparent mortality by the latter affection. Be this as it may, the mortality by pneumonia certainly appears disproportionately large in Boston, as well as in the State, and the mortality by bronchitis is correspondingly very small, if we compare our statistics with those of England.

under five years of age. In London, of all cases of bronchitis and pneumonia taken together, as many as 44 per cent. occur under five.

The causes of bronchitis and pneumonia are of slight interest in the present connection, as they are not removable or avoidable by measures of public sanitation. The prevention of these affections belongs exclusively to private hygiene, with one exception.

Several observers have recognized the existence of a special form of pneumonia which appears to be dependent upon a miasmatic infection by filth. Hence the name of "Pythogenic Pneumonia," which has been proposed. This view is founded on the frequent occurrence, during the hot summer months, of cases of pneumonia which assume to a certain extent an epidemic form, coincidently with typhoid fever, and prevail at such times quite independently of bronchitis, this disease occurring rarely during the warm season.[1]

If this view be accepted as correct, we may look upon pneumonia as being to some extent preventable by such sanitary measures as are found to operate successfully against the generality of "filth-diseases."

IV. Infant Mortality.

We have shown in Chapter II. that the undue mortality which each year takes place in Boston falls very unequally upon our population divided according to ages, and that its greatest pressure is felt among infants and young children at ages under five; of all infants under one year as many as 271 out of every 1,000 living die yearly, and of all under five, 97 out of every 1,000 die; of all our yearly deaths at all ages, over a quarter (27.0 per cent.) take place under

[1] See a paper on "Pythogenic Pneumonia," by Th. W. Grinshaw, and J. W. Munroe. (Dub. Journal Med. Sciences, May, 1875.)

one year of age, and over two-fifths (42.1 per cent.) take place under five. Such infantile death-rates have fitly been termed "Herodian."

We have also shown that a disproportionate share of this excess of deaths occurring among infants must be laid to the charge of our foreign population.[1]

The localities in which infant mortality attains its most inordinate rates are precisely those districts which we have already found to suffer most severely from other forms of disease, and which also yield the highest general death-rates. This circumstance seems to show that certain common conditions underlie, in this community, the prevalence of disease in general, of all kinds and of all ages.

In the distribution of infantile diseases, of which the most important are the diarrhœas, throughout the different wards of the city, we can recognize the predominant influence of local variations of two kinds, namely, variations of *density*

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[1] If our demonstration of this fact should not have appeared conclusive, the following additional evidence will assuredly leave no doubt in our reader's mind: "In Boston, during ten years, 1862 to 1871, there were born 20,867 children of American, and 42,582 of foreign fathers. In the same time, the deaths were 3,438 under one year, and 5,428 under five years, of the first class, and 7,719 under one year, and 13,943 under five years, of the second class.

"Of those that were born in American families, 16.47 per cent. died under one, and 26 per cent. under five years. Of those born in foreign families, 18.13 per cent. died under one, and 32.79 per cent. under five years.

"The mortality of the foreigners' children was 10 per cent. greater under one, and 26 per cent. greater under five, than that of children of natives.

"In Massachusetts, in the four years 1867 to 1870, of the children born of both foreign parents, the ratio of deaths under one year exceeded that of the children of Americans by 10 per cent., and under five years by 28 per cent.

"In this connection the comparative ratios of infants and children to those of all ages buried in the Mount Auburn and Catholic cemeteries in the vicinity of Boston agree with these deductions. During the periods examined, there were, of all ages, 19,735 buried in the Catholic cemeteries, of whom 5,688 or 28.7 per cent. were under one, and 11,486 or 58.2 per cent. under five. At Mount Auburn 16,949 were buried, of whom 1,973 or 11.6 per cent. were under one, and 4,771 or 28.1 per cent. under five." (Infant Mortality, by E. Jarvis, M.D. Fourth Annual Report of the State Board of Health of Mass., page 215.)

of population, and variations of *nationality*, native and foreign. Where the population is most dense and where there are most foreigners, and, *a fortiori*, where these two factors combine their effects, as is generally the case, there the "massacre of the innocents" takes place on the largest scale.

Thus, taking the distribution of *cholera infantum* in Boston: In 1870, Wards 1, 2, 7, 12 and 15, whose united populations amounted to 42.8 per cent. of the aggregate population of the city, yielded together 55 per cent. of all cases of cholera infantum occurring outside of public institutions. Ward 7 alone, containing 16.9 per cent. of our total population, supplied 24.4 per cent. of all such cases.[1] In 1874 these same five wards, whose populations amounted to 40.3 per cent. of our total population (by the census of 1875), supplied 54 per cent. of all cholera infantum, and Ward 7, with 9.1 per cent. of the aggregate population, supplied 15.7 per cent. of all the cases of this disease.[2]

Of the numerous *diseases* which contribute to the mortality occurring among infants and young children in Boston, we cannot ascertain the relative frequency except in a very rough and unsatisfactory way, such is the prevalence of imperfect or inaccurate diagnosis, and of careless registration. These shortcomings are more apparent in connection with the diseases of infancy than with any other division of our vital statistics, partly in consequence of the inherent difficulties of this branch of practice, and partly for lack of the special training which it requires.

The following table[3] represents an attempt to show the proportionate mortality due to the various diseases of in-

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[1] From Dr. F. W. Draper's figures. (Mortality of Boston in 1870, Second State Board of Health Report.)

[2] From figures given in the City Registrar's Report for 1874.

[3] From a report on Infant Mortality. (Fourth State Board of Health Report of Mass.)

fancy as commonly diagnosticated and registered in Massachusetts: —

Causes.	Massachusetts, 1870. Percentage on all deaths under five.	Causes.	Massachusetts, 1870. Percentage on all deaths under five.
Diseases of Brain	1.38	Canker	1.33
Bronchitis	1.02	Measles	2.03
Cephalitis	3.55	Infantile	4.76
Cholera Infantum	17.40	Pneumonia	6.85
Consumption	3.23	Premature Birth	2.52
Convulsions	4.80	Scarlet Fever	7.14
Croup	4.14	Tabes Mesenterica	2.74
Debility	1.95	Teething	2.92
Diarrhœa	2.57	Whooping-Cough	3.27
Diphtheria	1.57	Burns	0.55
Dysentery	2.88	Casualty	0.25
Enteritis	0.94	Lung Disease	0.29
Typhus Fever	1.34	Scrofula	0.55
Hydrocephalus	4.57		

To our mind, however, this table will not serve so much to show the causes of death among children as to illustrate the carelessness with which registration is conducted, and the loose and unscientific habits of diagnosis prevalent in this community; for, out of all the so-called "causes of death" there enumerated, nearly half are quite devoid of diagnostic significance. The list comprises a farrago of terms, of which some (as *hydrocephalus* and *typhus fever*) are misapplied in the most flagrant manner; others (such as *disease of the brain* and *lung disease*) only serve to designate the seat of disease without any attempt at diagnosis, and others again (as "*infantile*" and "*debility*") are utterly meaningless as regards the nature of the fatal disease.

In this table, as in all records of infant mortality, a large

proportion of fatal cases, in which death has been caused primarily by a variety of diseases, are promiscuously registered under the headings of *teething* and *convulsions*. These designations also are utterly unsatisfactory, inasmuch as they convey absolutely no definite idea of the real cause of death. Teething, on the one hand, is a physiological process, a phase of normal growth, coincident, to be sure, with a period of great danger to health and life, namely, weaning, but which stands in a very doubtful causal relationship to the diseases which may then prove fatal. To ascribe teething as the cause of death is hardly more rational, in such cases, than to say that a child died of the *closing of the fontanelles*, or of the *growth of hair*, or of any other phase of development, coinciding with the period of danger. No doubt the eruption of teeth may occasionally cause some disturbance, perhaps even of a serious character (?); but on this point there is much doubt among those most experienced in infantile pathology. Conceding thus much, however, it is safe to assert that the large proportion of deaths everywhere imputed to this imaginary cause are merely illustrations of inadequate diagnosis. Convulsions, on the other hand, are but a frequent epiphenomenon of serious or fatal infantile disorders; they often constitute the closing scene of fatal disease, but should no more be made to do duty in registration as the "cause of death," than *asphyxia by bronchial mucus*, which in adults is so often the ultimate phenomenon of disease, and the direct mechanical cause of the cessation of life.

Taking into consideration, then, the comparatively valueless character of registration in connection with the causes of death among children, we shall not attempt any nice discrimination between the various nosological entities which take part in the production of our infant mortality; but we shall content ourselves with the following rough classification, in which certain comprehensive classes of disorders are enu-

merated in the order of their importance, beginning with the most destructive to life among young children: first, *Diarrhœal diseases;* second, *Tuberculosis*, in all its forms; third, *Scarlatina;* fourth, *Pneumonia;* fifth, *Small-pox.*

As regards the degrees of prevalence of these diseases among young children, the following data yield approximative information. We know that of all the fatal cases of diarrhœal disease, amounting to over 12 per cent. of our total mortality, two-thirds consist of cholera infantum, occurring mainly during the first year of life; forms of fatal bowel disease, registered under other names than cholera infantum, also undoubtedly find the great majority of their victims during the first years of life; so that of all cases of fatal diarrhœa all but a trifling portion belong to infant mortality. Of all deaths by scarlet fever and small-pox in Boston, as many as 69 per cent. of the former, and 26.5 per cent. of the latter, take place under five years of age.

The *causes* of these diseases are full of interest to the sanitarian. From this point of view we shall consider each class successively, beginning with the least important among them; these having been summarily disposed of, we shall be able to give our undivided attention to the careful investigation of the causes of *infantile diarrhœa*, which is to us the most interesting of all the disorders of childhood, on account of its excessive prevalence and fatality, and on account of its eminently preventable character.

I. *Tuberculosis.* — The various forms of tubercular disease which occur among infants and children, comprise cases registered and scattered under the followings headings: phthisis, lung disease, hydrocephalus, tubercular meningitis, cephalitis, disease of brain, convulsions, teething, tabes mesenterica, marasmus, scrofula, debility, and "infantile." They result from constitutional disease which is transmitted from consumptive parents to their children, and in propor tionas

the adult members of any population are liable to consumption in such proportion will these early forms of tuberculosis prevail among their offspring.

II. *Scarlatina.* — This disease arises in every case from contagion. The wide-spread and constant prevalence among us of this as well as of the other less fatal eruptive fevers is due to the *unrestrained dissemination of contagia* which is constantly taking place. Under these conditions the spread of the disease is proportional to the density of the population and to the carelessness of its members; it therefore assumes the greatest proportions among the ignorant classes, who inhabit the poor and crowded districts of the city.

III. *Small-pox.* —Neglect of early vaccination is the well-known cause of the undue prevalence among young children of this disfiguring, mutilating, and often fatal disease. The simple fact that children under five years of age, while constituting 12.5 per cent. of our total population, supply 26.5 per cent. of all fatal cases of small-pox, is a sufficient demonstration of the wide-spread and criminal neglect of this all-powerful means of protection, and of the manifest inadequateness of a law which allows two years for the performance of this imperative duty.[1]

IV. *Infantile diarrhœal diseases.* — These are registered under a variety of headings, of which the most common is

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[1] "The present law of the State concerning vaccination gives the boards of health all needed power, except that it allows two years for the vaccination of children. It would have been better to require it in the first six months. There seems to be no reason why four per cent. of the whole living population should be legally permitted to furnish food for the pestilence. It may be said of primary vaccination that it is free from danger, and vaccination in the first few months of life has been proved to be safe, by an experience of millions of cases in every civilized country." (Small-pox in Mass., by G. Derby. Third State Board of Health Report, page 303.)

"The Registrar-General of Scotland again, in his report issued on the 4th inst., repeats his opinion (frequently expressed in former reports), that the period of six months, during which newly-born children may be permitted to

cholera infantum; other more vague terms in use are *diarrhœa, enteritis, bowel disease.* A large proportion of cases called *marasmus* are also evidently of this character, as may be recognized from the fact that they prevail chiefly during the summer months.[1]

As regards these disorders *age* stands foremost among the predisposing causes. The maximum frequency of the diarrhœal diseases is during the first months of life; cases become less frequent after the lapse of the first year; and after two years of age, when the perils incidental to change of food are passed, these diseases are much less common.[2] To state these conditions briefly, *in strict proportion as the infant, by virtue of his age, is dependent for proper nourishment on the mother's milk, and in proportion as he is deprived of this indispensable and only suitable aliment, in such proportion, other conditions being equal, is the liability to fatal diarrhœal disease.*

We will now examine the external conditions under which the diarrhœal diseases of infancy arise; in the careful study of these conditions we may find a clue to the peculiar agencies which constitute the determining causes of these disorders.

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remain unvaccinated without rendering their parents or guardians liable to penalty, should be abridged." (Medical Times and Gazette, Aug. 21st, 1875.)

[1] In 1872, out of 305 cases called "marasmus," 176 or 58 per cent. occurred during the four months of July, August, September and October. (See City Reg. Report for 1872, Table XI.)

[2] The greater liability to deaths existing during the first twelve months, as compared with the following four years of life, is illustrated in the Charts IV., V., VI., and VII., showing the monthly deaths under one, and from one to five, in connection with the monthly temperatures. We see therein, that in the hottest season, while the mortality from one to five is increased by one-half, or at most doubled in an unusually hot summer (1872), the mortality under one is more than doubled, or even tripled. By comparing these charts we see that infants under one suffer much more from unusual degrees of heat than children aged from one to five.

It is well known that diarrhœal diseases prevail among infants almost exclusively in *cities*, and there during only the *hottest weeks of the summer season*. Let us investigate separately the influence exerted by each of these conditions.

1. Influence of *locality*. — "Summer diarrhœa among infants is almost exclusively an urban complaint." [1] Moreover, among cities those are found to be most severely visited by this form of disease which are most densely populated, and where the provisions for the immediate removal of excreta, comprising privies, household drains, and public sewers, are most imperfect and inadequate to their task. As regards density of population, it has long been a demonstrated fact, "not only that the mortality is greater in town than in country districts, but that the mortality of town districts has a certain relation to their density." [2]

The following table [3] shows that the increase of mortality due to this influence falls most heavily upon young children :

Towns.	Living to one square mile.	General Death-rate per 1,000 living.	Death-rate under five per 1,000 living at that age. (1851–1860.)
London	50,000	25.1	82.27
Leeds	87,256	27.2	102.77
Manchester	100,000	33.7	117.25
Liverpool	138,000	34.8	131.98

[1] Weekly return of the Reg. Gen. of England. Lancet, July 3d, 1875.

[2] Fifth Annual Report of Reg. Gen. of England, page 419. See also sixteenth Annual Report, p. xvi., and supplement to twenty-fifth Annual Report, p. xxxiii.

[3] The figures in the third column of this table are extracted from the supplement to the twenty-fifth Annual Report of the Reg. Gen. of England, page xiv. The rest of the table is from Dr. Ed. Jarvis's paper on Infant Mortality, page 224.

2. Influence of *season*. — Urban districts, even when most densely populated, do not suffer at all times from infantile diarrhœa, to the production of which another condition is indispensable, namely, a *high temperature*. The intimate connection existing between summer heat and infantile diarrhœa is such that, in our climate, cases of cholera infantum are hardly known to occur except during the summer quarter; they then take place during a few weeks in such numbers as to raise our general mortality to higher altitudes than are attained in any other season. It is owing to this circumstance that the maximum of our general yearly mortality occurs in summer, whereas in more temperate and more equable climes, as in England, the maximum mortality of the year occurs in winter.[1] On reference to chart III., showing the weekly mortality by all causes, and the weekly deaths by cholera infantum throughout the year 1874, it will be seen that our general death-rate offers two maxima in the course of the twelvemonth, the higher of which occurs in the hottest weeks of the year, and is manifestly due to the prevalence of cholera infantum, while the other takes place in the coldest season; this second and lower maximum is the counterpart of the English maximum, and is due to the same causes, namely, to the prevalence of affections of the respiratory organs occasioned by wintry weather. The winter season is certainly much more severe in New England than in England, and its influence would be very much more apparent in our monthly mortality, were it not dwarfed by the still greater destructiveness of our hot season. Harsh as our winters are, they are far less pernicious than our scorching summers.

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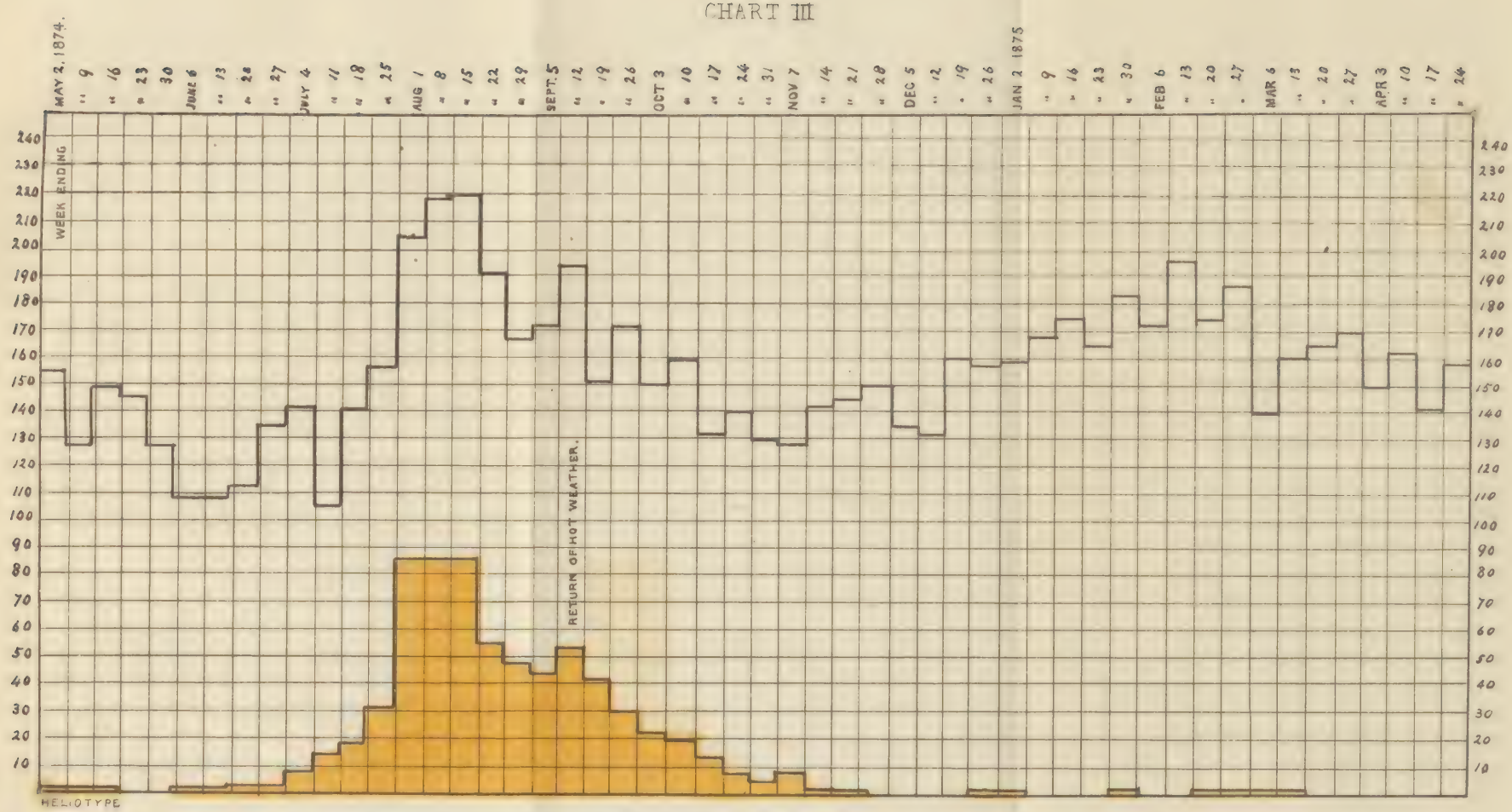
[1] Berlin resembles American cities in the distribution of deaths throughout the months of the year; infants under one there supply over a third of all the deaths, and the maximum mortality occurs in summer. (Virchow. Berlin. Klin. Wochenschrift, Dec. 9th, 1872.)

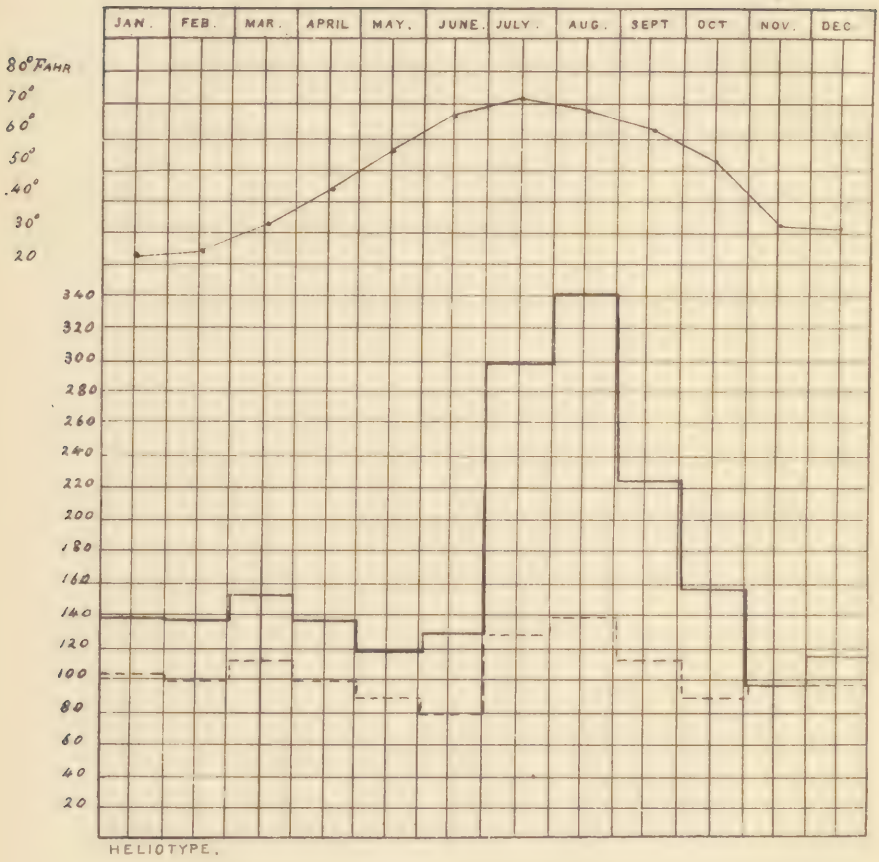
CHART III



BOSTON 1874.75 THE BROKEN BLACK LINE SHOWS THE WEEKLY DEATHS BY ALL CAUSES THROUGHOUT THE YEAR FROM MAY 1874 TO APRIL 1875
THE COLORED PART SHOWS THE WEEKLY DEATHS BY CHOLERA INFANTUM.

CHART VII.

BOSTON 1873



HELIOTYPE.

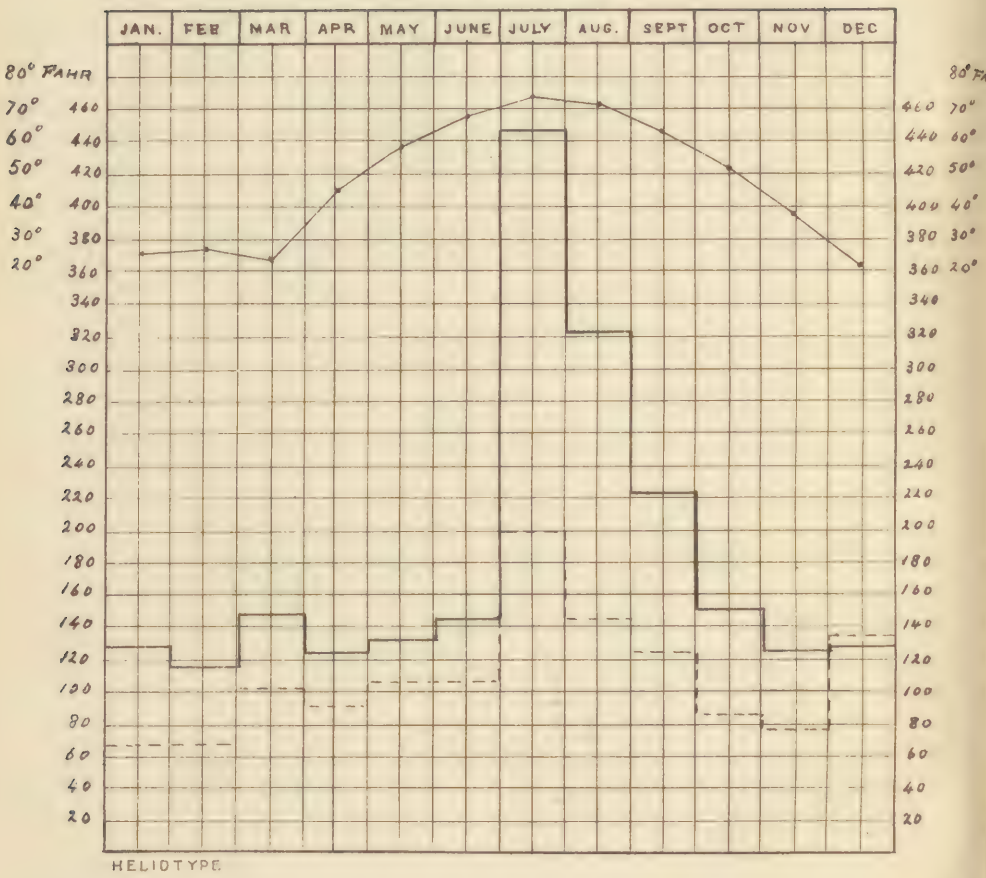
EXPLANATION: THE UPPER LINE ·—·—· SHOWS THE MONTHLY MEAN TEMPERATURES (CAMBRIDGE)

THE MIDDLE LINE ——— SHOWS THE MONTHLY DEATHS UNDER ONE YEAR OF AGE

THE LOWER LINE - - - - SHOWS THE MONTHLY DEATHS FROM ONE TO FIVE YEARS OF AGE

CHART VI

BOSTON 1872



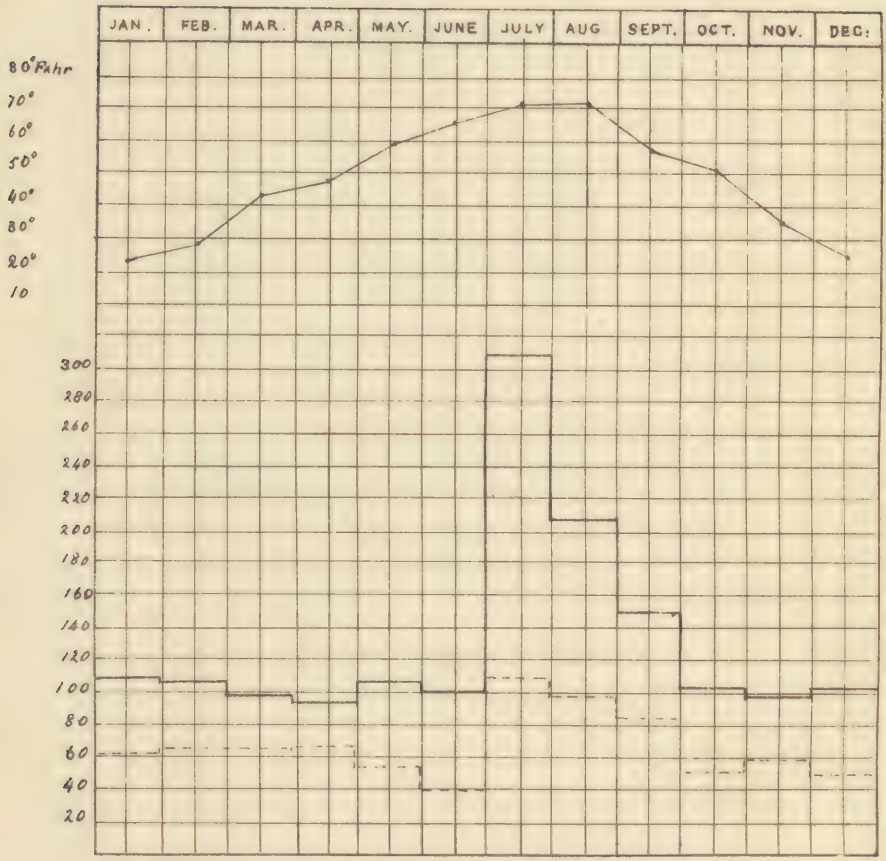
EXPLANATION: THE UPPER LINE ——●—— SHOWS THE MONTHLY MEAN TEMPERATURES (CAMBRIDGE)

THE MIDDLE LINE ——— SHOWS THE MONTHLY DEATHS UNDER ONE YEAR OF AGE.

THE LOWER LINE - - - - SHOWS THE MONTHLY DEATHS FROM ONE TO FIVE YEARS OF AGE.

CHART V.

BOSTON 1871



HELIOTYPE.

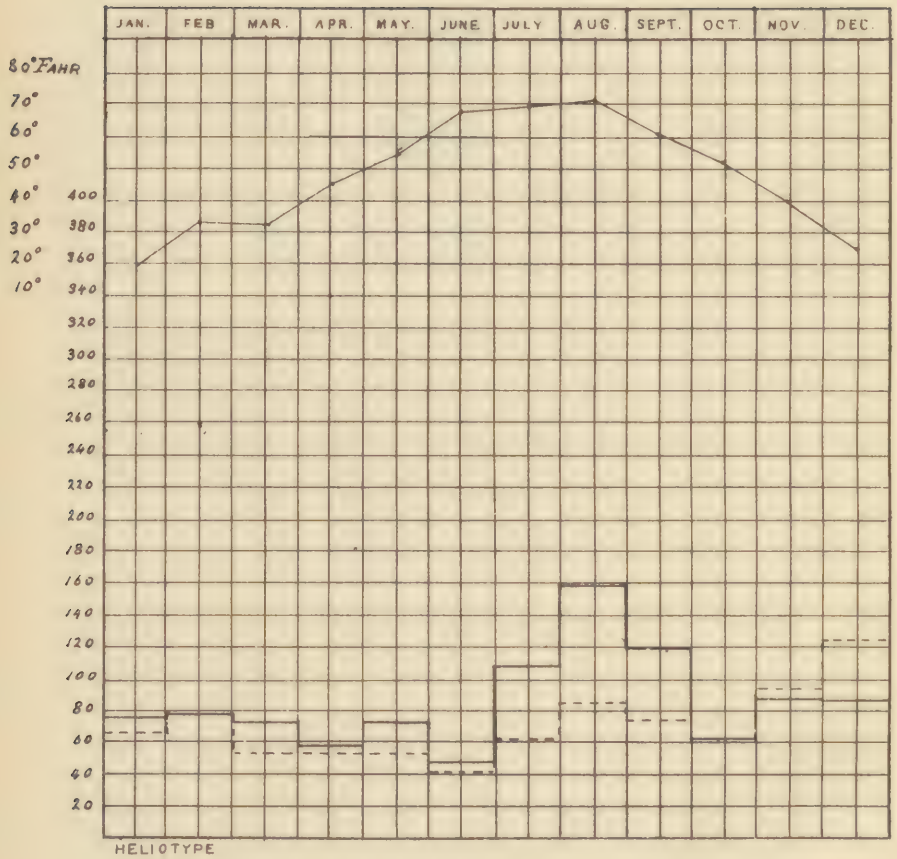
EXPLANATION: THE UPPER LINE ——— SHOWS THE MONTHLY MEAN TEMPERATURES (CAMBRIDGE)

THE MIDDLE LINE ——— SHOWS THE MONTHLY DEATHS UNDER ONE YEAR OF AGE

THE LOWER LINE - - - - SHOWS THE MONTHLY DEATHS FROM ONE TO FIVE YEARS OF AGE

CHART IV

BOSTON 1867



HELIOTYPE

EXPLANATION: THE UPPER LINE ——— SHOWS THE MONTHLY MEAN TEMPERATURES (CAMBRIDGE)

THE MIDDLE LINE ——— SHOWS THE MONTHLY DEATHS UNDER ONE YEAR OF AGE

THE LOWER LINE - - - - SHOWS THE MONTHLY DEATHS FROM ONE TO FIVE YEARS OF AGE

The distinct influence exerted by high temperatures on young children is illustrated by the accompanying charts, relating to the years 1867, 1871, 1872 and 1873, each of which shows the mean monthly temperatures, and the monthly deaths under one, and from one to five years of age, throughout the year. The effect of the invasion of high temperatures is each year the same, the mortality varying, however, in proportion to the intensity of the heat. In moderately hot summers (1867, 1871, 1873) the mortality under one is doubled or tripled during the hottest month, while the mortality from one to five is increased by half, or at most doubled; in a hot summer month, on the other hand (July, 1872), deaths under one are suddenly almost quadrupled, the deaths from one to five being barely doubled. Thus we see that the destructive influence of excessive heat is felt much more acutely during the first year of life than subsequently, while the reverse is noticeable with regard to the influence of winter cold, which tells more severely upon children who have passed the age of one year.

Another point to be noticed in nearly all these Charts is that the invasion of cholera infantum is sudden, the maximum mortality being attained very speedily, and having a short duration, while its subsidence is gradual, extending over several months.

Such being the destructive effects of our hot weather, we should expect our yearly general death-rates to be distinctly affected by the variations in the summer temperatures. The following table shows that such is the case. We here see the influence of summer heat upon the diarrhœal mortality, the most striking example thereof being afforded by the figures relating to the year 1872; the effects of the unusually hot summer of that year contributed in a considerable degree to the high death-rate which then prevailed.

Years.	Temperatures at Cambridge Observatory.		Diarrhœal Diseases.	
	Mean Temp. July and Aug. °Fahr.	Mean Temp. during the hottest Month.	Death-rate per 1,000 living.	Percentage to all Deaths.
1867	69°.8	70°.4	2.55	9.20
1868	71°.6	73°.6	3.10	13.20
1869	69°.2	70°.8	2.69	11.44
1870	72°.3	72°.9	3.63	14.92
1871	70°.8	70°.9	. .	11.29
1872	71°.9	73°.1	4.10	13.41
1873	69°.4	71°.6	3.29	11.71
1874	. .	. .	2.70	11.32

The facts observed in New York in 1872 [1] are very striking. The months of August and September were not very hot, but the mean temperature of July was 79°.57, being 3°.43 greater than that of the corresponding month during the previous ten years. In consequence of this one month of excessive heat, the summer quarter of 1872 proved to be the most fatal ever known in New York. During the quarter, deaths under one were 39.8 per cent. of all deaths, and of the total mortality under one occurring in the whole year, 40.8 per cent. took place during the three summer months.

The destructive action of heat upon infants is sufficiently manifest. We are now led to inquire what can be the *nexus* existing between these two factors, *urban density of population*, and *extreme summer heat*, whose conjunction appears indispensable to the production of fatal infantile diarrhœa on a large scale, while neither condition suffices by itself. Inasmuch as the influence of mere heat alone, as experienced in rural districts, or even in cities among infants belonging

[1] See third annual report of the N. Y. Board of Health, 1873, page 106.

to the upper classes, appears to be comparatively harmless to infants, it may be inferred that excessive temperatures, when harmful, as among the poor in cities, do not exert their pernicious action by virtue of any direct influence upon the infant; but rather in an indirect manner, and through some intermediate agency peculiar to densely agglomerated populations. This agency, which is peculiar to crowded cities, being there proportional in noxious activity to density of population, and which develops its destructive action under the ripening influence of extreme heat, is *filth*.[1]

We are already familiar with the fact that filth-infection is a powerful cause of diarrhœal disease in general. Now cannot we determine with more precision the special mode of infection by which fatal infantile diarrhœa is produced? By considering attentively the circumstances attending the development of this form of disease, we may perhaps be able to approximate more closely the solution of this problem.

Some light is thrown upon the subject by the contrast to be found in *rural* and *urban* forms of filth, considered with reference to their respective modes of infection, and to the resulting diseases. In rural and urban districts alike uncleanliness consists in the non-removal of excreta and refuse matter of all kinds; but the results differ considerably in town and country. *In the country* the air undergoes little or no permanent contamination, being continually and rapidly renewed or diluted; on the other hand, the drinking-water and food are liable to frequent contamination by filth, in consequence of the imperfect separation of sewage and water-supply which is characteristic of rural habits; the incoming and the outgoing household waters are liable to become mingled in

[1] Dr. E. H. Greenhow's researches have demonstrated "that the seats of a high diarrhœal mortality among young children chiefly exist among those dense urban agglomerations of life, where the well-organized removal of refuse matters is so specially indispensable to health." (J. Simon, Introd. Report, 1858.)

such places, and filth-infection takes place. The resulting disease chiefly takes the form of typhoid fever, wherever that disease is epidemic; hence the greater frequency of this disease in rural as compared with urban districts.[1] Cholera infantum, on the other hand, occurs on a comparatively small scale. *In cities*, the conditions are quite different. Here the water-supply is pure, being brought from a distance, and sedulously preserved from contamination by sewage, and therefore does not serve in any appreciable degree as a vehicle of infection. But the air is impure; especially is this the case in densely populous districts, where, the houses being high, and the streets and courts narrow, the sun rarely penetrates, and ventilation is imperfect. When to these already unfavorable conditions are added the effects of an inadequate provision for the removal of the various excreta of a superabundant and habitually unclean population, the result is that the air is permanently laden with foul matters, comprising effluvia from the skins and lungs of the inhabitants, noxious gases and vapors from sinks, nooks and crannies, soil-pipes, gutters and cesspools, and, worse still, floating excremental molecules from choked-up privies, drains, and sewers. Air reeking with these filthy matters requires only the ripening action of our midsummer heat to be kindled, as it were, into a blaze of poisonous putridity. When these conditions are fulfilled, as is the case every summer in Boston, miasmata of a kind peculiar to urban districts are generated, which seem to concentrate their noxious influence chiefly upon very young children. Herein, then, is the partial cause and explanation of our terrible infantile death-rates.

But the poisonous miasmata which are thus evolved from urban filth under the influence of high temperatures do not, by any means, constitute the only agencies by which diarrhœal

[1] "There can be no doubt that typhoid fever in Massachusetts is a disease of scattered communities rather than of crowded towns; of rural rather than of urban districts." (Second Annual State Board of Health Report, page 118.)

disorders are produced in infants. Another potent influence acts in conjunction with filth-infection, both as a predisposing and a determining cause of intestinal derangement. We refer to the well-known pernicious effects produced in infants by *improper food*. This agency is so thoroughly established as a cause of fatal infantile diarrhœa, that any attempt to demonstrate its influence would be quite superfluous. We will simply state, as a proposition upon which all competent observers are agreed, that the *only* suitable food for infants is the maternal milk; and that, in default of this, the natural aliment of the child, the only tolerable substitute is good cow's milk, suitably prepared.[1] In the very unfavorable conditions, however, under which infant life exists in poor and crowded urban districts, it is exceedingly doubtful if it be possible for infants to be successfully bottle-fed, however carefully the rules for this mode of artificial alimentation be carried out. Successful results may be obtained in the country, but we think it may be asserted as a fact that in towns the only safety for infants lies in maternal lactation.[2]

All other food than milk is improper for infants, whether supplementing, or altogether replacing lactation; the younger the infant, and the higher the temperature, the greater is the peril to be apprehended from an unsuitable diet.

Now, what do we know, by observation, to be the common treatment of infants among the classes whose offspring, by virtue of circumstances connected with social condition, are already most exposed to the dangers of summer filth-infection? Too often, in consequence of ignorance, carelessness and

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[1] See article on "The Artificial Feeding of Infants," by Dr. Charles E. Buckingham, Boston Medical and Surgical Journal, June 3d, 1875.

See also a set of "Rules for the Management of Infants during the Hot Season," drawn up by the Obstetrical Society of Philadelphia, March 5th, 1874.

See also a paper on "Infantile Hygiene," by Dr. Van Wyck. Transactions of the Medical Society of the State of California, 1873 and 1874, page 66.

[2] See a paper on Infant Mortality, by Dr. John S. Parry, Social Science Association of Philadelphia, papers of 1871, pages 20 and 21.

poverty, the substitutes for mother's milk and mother's care are an unclean bottle, which is filled with souring milk, adulterated by the seller with whatever water may have come handy, and leavened by the putrefying reliquiæ of previous messes, and whose ill-smelling contents are administered, at the biddings of caprice or chance, by a little sister or an aged grandmother. Often, again, little or no attempt is made to obtain for the infant a proper supply of his only pabulum, milk; cheap and convenient substitutes are sought in various farinaceous compounds, which to the very young infant are hardly more nutritious than so much plaster of Paris; or else the easy expedient is adopted of simply feeding the child from the food prepared for the grown-up members of the family. Moreover, among our poor classes, infants do not suffer only from the effects of improper food, but also from the administration of alcoholic liquors,[1] and of various drugs, chiefly opiates, which are given either as remedies for indisposition, or simply as narcotics to prevent the child from disturbing its mother.

Such being the agencies by which fatal diarrhœal disease is occasioned in infants, we naturally find that excessive rates of infant mortality prevail chiefly in connection with *ignorance* and *poverty*. However discouraging the fact may be to the sanitarian, these deficiencies constitute the underlying conditions, the *fons et origo*, of the insanitary state in which the unhealthy classes of our population live and die.

Ignorance and its products, heedlessness and criminal neglect, are the manifest origin of much disease and mortality among young children. Now ignorance, as statistically expressed in the form of *illiteracy*, is a condition which, in our community, prevails in its marked degrees almost

[1] Gin is a very favorite remedy among certain classes of our inhabitants for infantile ailments. It is also given with a view to its narcotic effects.

exclusively among our foreign inhabitants.[1] We therefore find that ignorance and foreign nationality go hand in hand in our community as causes of infantile diarrhœal disease. In proof of the connection existing between these factors, we submit the following table, which exhibits facts derived from the national census of 1870 relating to nine States. These are arranged in the order of their increasing mortality by *diarrhœal diseases*, and by *cholera infantum*, while collateral columns show the proportions of foreign inhabitants, of Irish inhabitants, and of illiteracy existing in the total population of each State.

States.	Cholera Infantum.		Diarrhœal Diseases.		Nationality.		Illiteracy.
	Death-rate per 1,000 living.	Percentage to deaths by all causes.	Death-rate per 1,000 living.	Percentage to deaths by all causes.	Foreigners per 100.	Irish per 100.	Unable to read, aged 10 years and upwards, per 1,000.
Maine	0.29	2.31	0.72	6.79	7.7	2.5	21.5
Vermont	0.32	2.92	0.92	8.47	14.2	4.2	45.9
New Hampshire .	0.44	3.23	1.00	7.35	9.3	3.8	23.9
Connecticut . . .	0.71	5.57	1.19	9.39	20.7	13.1	36.6
Pennsylvania . .	0.76	5.09	1.51	10.09	12.6	6.7	37.4
New York	0.82	5.17	1.88	11.88	25.7	12.0	37.3
New Jersey . . .	0.86	7.39	1.47	12.60	20.8	9.5	40.8
Rhode Island . .	0.91	7.18	1.44	11.41	25.4	14.5	70.4
Massachusetts . .	1.16	6.51	1.93	10.81	24.2	14.8	51.4

We see by these figures that, of the nine States compared, Massachusetts, with the highest death-rates by cholera infantum and diarrhœal disease, also has the largest proportion

[1] By the State census of 1865, out of the total population of Boston, numbering 192,318 inhabitants, as many as 12,380 were classed as illiterate. Of these only 234 were native Americans, the rest being foreigners.

of Irish population, and, except Rhode Island, the largest proportion of illiterate inhabitants. Maine, on the other hand, heads the list in all these particulars. It is impossible to escape the inference that these forms of mortality are intimately associated with the prevalence of mental deficiencies of exotic origin, for which our community can hardly be held responsible. So long as a large proportion of our inhabitants consists of ignorant foreigners, so long will the inevitable consequences of such ignorance as characterizes them be apparent in our yearly records of mortality.

The lack of moral sense which so often accompanies ignorance is the cause of much stupid, or wilful and even criminal neglect of the most obvious duties involved in the care of infants. The heedless indifference with which the approach of alarming symptoms is viewed, and the delay in seeking medical assistance, are undoubtedly the occasion of much avoidable mortality.[1]

Poverty also tells severely upon infants, notwithstanding the limited number of their requirements, which comprise only food, pure air, cleanliness and clothing. When, by consequence of inability to gain a subsistence, or from lack of thrift and intelligence, or by misspending of wages on drink, the father cannot earn enough to maintain his family, then the mother herself has to labor, and the exigencies of her work either take her altogether away from the care of her child, or prevent her from nursing it and attending to its

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[1] "Few persons outside of the medical profession, and few in it, who have not practised among the poor, can conceive how many children die from want of proper medical advice. Among the poorer classes it is not uncommon to postpone sending for the doctor until near to the close of the life of the child, and every physician has often been told, when called to one of these patients, that it was not expected that he would cure the infant; "but you must come, you know, as we must have a line to bury the little darlint." (Paper on Infant Mortality, by John S. Parry, M.D., Social Sc. Assoc. of Philadelphia, papers of 1871, page 14.)

wants when needful. Attempts are then made to replace or supplement the lack of mother's milk by cheap modes of artificial feeding, with such disastrous results as have been described. Intemperance enhances the poverty of the household by the waste of valuable resources which it entails, and thus impairs the vitality of the entire family, from the tippling parents down to the babe at the breast, or, more correctly, the babe at the bottle, whose milk-supply suffers in quality by consequences of the *res angusta domi*.

In conclusion we will sum up the principal causes of infantile diarrhœa in the following formula, which expresses, in the condensed form of an algebraic equation, the influence exerted by the various factors: —

$$\frac{(\text{Improper food} + \text{urban filth}) \times \text{temperature}}{\text{Months of age}} = \text{Infantile diarrhœa.}$$

For the *prevention* of our undue infant mortality a variety of measures are called for.

The removable causes which contribute to its production are the following, the remedy for each being sufficiently obvious: —

1st. The reckless dissemination of contagia, which is the source of much preventable disease.

2d. The neglect of early vaccination.

3d. The filth-infection which is constantly being occasioned by the lack of ventilation in overcrowded habitations, and by the inadequate provision for the speedy removal of refuse matters from houses, courts, and streets, from privies, drains, and sewers.

The unremovable causes comprise: —

1st. Those connected with climate.

2d. The ignorance and poverty which so extensively prevail among certain classes of our population. These agencies, though not amenable to sanitary measures, properly so called, are nevertheless not altogether unremovable. Con-

siderable improvement may perhaps be looked for from educational influences tending to better the mental and moral condition of the ignorant poor classes, and inculcating in parents a proper sense of their duties towards their offspring, together with habits of cleanliness, and some knowledge of infantile hygiene.[1] To accomplish these much-needed reforms is a duty of which the responsibility may be said to rest with the minister or the priest, and the schoolmaster, rather than with the health-officer.

The Causes of Local Variations of Mortality.

We have passed in review, with special reference to their general causes and prevention, the principal diseases which occasion our yearly mortality. An important question, which has been before us since the commencement of our inquiry, and which we have constantly postponed, now calls for attention. We refer to the *causes of our local variations* of mortality.

To many of our readers it must have appeared one of our most obvious and important duties to ascertain as exactly as possible the situation of the particularly unhealthy parts of the city, with a view to determining the causal connections existing between the topographical characters of the various wards or districts and their sanitary condition. It must have been expected of us that, having pointed out the precise

[1] In London, missions among the poor and ignorant classes have been organized, under the leadership of Miss Octavia Hill, aided by a society of ladies and gentlemen. Much good might doubtless be accomplished by an organization of this kind, which should have for its object the prevention of infant mortality. Poverty-stricken mothers, might be enabled, by a little timely assistance, either to nurse their offspring, or to procure a proper supply of pure milk, the latter being perhaps supplied by the society. Sound rules for the management of infants, especially during the hot season (such as those published by the Obstetrical Society of Philadelphia, March 5, 1874), might be promulgated, so as to counteract the effects of the prevalent dense ignorance of infantile hygiene.

spots where sanitary measures are most urgently called for, we should be prepared to state definitely the causes, removable or otherwise, of the insanitary condition of those localities, and that we should be able to prescribe suitable measures of relief. Such was, at first, our own conception of our task. As we became more familiarized, however, with the problems before us, we grew less sanguine of being able to accomplish much in this direction, and now we cannot but recognize that such results as we have obtained are likely to prove of little value as indications for the direction of local sanitary measures. The desideratum was that we should determine to what extent physical conditions attaching to locality are responsible for high local rates of mortality; this having been accomplished, it would be comparatively easy to determine the part to be played by sanitation, and to prescribe measures designed to suppress or mitigate such local causes of disease as should appear to be removable.

The difficulties encountered in the course of such an inquiry are, however, very great, partly on account of the deficiency of statistical data relating to the various subdivisions of our population, and partly on account of the extreme complexity of the etiological questions involved. It is certainly easy to point out the districts in which excessive mortality prevails. The City Registrar gives us the yearly deaths by all causes, and by consumption, and, occasionally, the yearly deaths by certain other specified diseases, which have occurred in each ward. The census, on the other hand, gives us, every five years, the population of the city divided into wards. From these data the mortality of each ward can be ascertained. But, from these facts, to ascertain to what extent the local variations of mortality are dependent upon topographical conditions is a much more difficult problem.

The question which arises is, whether the localities which suffer from high death-rates are in themselves *unwholesome*, the degree of such local unwholesomeness being propor-

tional to the elevation of the local death-rate, or whether the excessive mortality depends upon the fact that the locality is inhabited by an *unhealthy population*, whose members import or generate the disease which prevails in their midst. In the first case the necessity of sanitary intervention is clearly apparent; unfavorable local conditions of soil, of site, of drainage, etc., must be remedied, or the locality must be abandoned, and improvement to health will surely ensue among the inhabitants. But if, on the other hand, the fault lies wholly or in great part with the inhabitants themselves; if their excessive mortality results chiefly from inherited constitutional disease and from acquired physical weakness due to poverty, to faulty habits of hygiene, and to imperfect acclimatization, then the unhealthy condition of the locality in question is evidently dependent upon causes which are removable only in a partial degree, perhaps at a remote period, and chiefly by means of agencies which do not come within the province of sanitation as generally understood.

In point of fact, these two factors of insanitary condition often prevail collaterally, their effects being so blended together that it is very difficult, if not impossible, to discriminate between them. Therefore, although some districts of the city (such as part of Ward 9, around Ruggles street) undoubtedly constitute, *per se*, unwholesome dwelling-places, in consequence of defects of site, of soil, of drainage, etc., the degree of the insanitary influence exerted by local conditions of this order cannot be estimated by comparisons between the various local death-rates.

As a case in point, let us suppose that we wished to determine the relative salubrity of *old* and *new* land. Our records of mortality[1] for 1870 show that the new land of

[1] The rates here quoted are borrowed from Dr. Draper's tables, for the construction of which a special enumeration of our population was made, the city being divided into twenty-four *Health-Districts*, which are numbered from

Ward 6 (Health-District 28, of Dr. Draper, extending from Commonwealth avenue to Charles river) was by far the healthiest district of the city, the death-rate there prevailing in 1870 having been as low as 5.7 per 1,000 living. The new land of Ward 9 (Health-District 32, west of Berkeley street and Columbus avenue) was the next healthiest district, the death-rate there having been only 9.8 per 1,000. On the other hand, the new land of Ward 7 (Health-District 29, on the western side of the channel) is perhaps the most unhealthy district in the city; here the death-rate was 27.3 per 1,000. Then, again, a part of Ward 6 (Health-District 27) is situated upon old land, much of which is also high; here the death-rate was 15.6. In a part of Ward 4 (Health-District 25), which resembles the preceding in topographical character, the death-rate was 15.2. Ward 2, however, which is also old and in part high land, showed a very high death-rate, amounting to 29.2 per 1,000.

Evidently, therefore, we do not find in the site nor in the nature of the soil any distinct clue to the causes of these great differences in sanitary condition. What, then, is the cause of the local variations? We learn, upon examination of the population of these districts, that Wards 6 and 9, whose death-rates are low, are chiefly inhabited by native Americans of the wealthier class; not only are these constitutionally stronger at all ages, and better instructed in matters of hygiene than our foreign inhabitants, but they also have fewer children, and their families comprise a considerable number of servants, who are either childless, or have children residing elsewhere; therefore the population of these wards contains a large proportion of adults, among whom low death-rates prevail, and an unusually small proportion of infants and children, among whom mortality is high. For these

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twenty to forty-three, to avoid all chance of their being confounded with wards. See a paper on the "Mortality of the City of Boston in 1870," by Dr. F. W. Draper, in the second annual report of the State Board of Health of Mass.

reasons, the death-rates which prevail among inhabitants of this class are low, whatever the locality which they inhabit, whether the soil be old or new, high or low; and from their low death-rates no correct inference can be drawn respecting the salubriousness of the site or soil upon which they dwell. Wards 2 and 7, on the other hand, contain populations of which nearly a half (47.9 per cent.) is foreign-born, and of which fully three-quarters must be of foreign parentage. The inhabitants of these districts are for the most part poor, ignorant, and thriftless; they live in crowded homes; moreover, being very prolific, they comprise a large proportion of infants and children. Under such conditions, high rates of mortality must prevail among populations of this class, wherever they dwell, and however naturally salubrious the locality into which they have transported their constitutional infirmities, and their characteristic *modus vivendi*.

Hence the difficulty of deciding upon the comparative merits and demerits of old and new land, by means of comparisons based upon the death-rates which prevail among their respective inhabitants.

The following tables show the death-rates by all diseases, and by consumption, which prevailed in 1865 and in 1870, throughout the city divided into wards. The wards are arranged according to their death-rates, beginning with the lowest. Collateral columns are appended, in order to exhibit other facts which may throw some light upon the causes of the local variations of mortality.

Wards.	Boston, 1865.				
	Death-rates per 1,000 by all Diseases.	Death-rates per 1,000 by Phthisis.	Irish per 100 Inhabitants.	Persons to a Dwelling.	Illiteracy per 100 Inhabitants.
IV.	14.6	2.13	23.6	11.07	2.59
VI.	15.5	1.82	15.2	7.70	.90
IX.	17.8	2.91	16.9	8.57	2.43
XI.	18.5	3.21	15.6	7.65	2.75
X.	19.6	3.22	23.7	11.94	8.66
V.	19.8	4.61	15.0	8.90	2.77
VIII.	20.4	3.65	29.7	11.12	7.40
II.	21.7	3.31	17.5	8.12	2.87
XII.	22.5	4.94	25.6	7.34	5.49
VII.	26.3	6.09	42.9	16.50	13.43
III.	27.9	4.34	34.2	12.28	5.58
I.	28.5	4.80	32.8	16.50	7.43

The death-rates of the various wards range from 14.6 to 28.5. The first six wards of the series, as arranged above, yield a mean general death-rate of 17.6 per 1,000, and a mean death-rate by phthisis of 2.98. They contain 18.3 per cent. of Irish population. The last six wards yield a mean general death-rate of 24.5, and a mean rate by phthisis of 4.52. Their mean percentage of Irish inhabitants is 30.4. The mean death-rate of the last three wards is 27.6; their mean death-rate by phthisis is 5.07. Their population comprises 36.6 per cent. of Irish inhabitants.

Wards.	Boston, 1870.			
	Death-rates per 1,000 by all Diseases.	Death-rates per 1,000 by Phthisis.	Foreigners per 100 Inhabitants.	Persons to a Dwelling.
XI.	16.7	3.2	23.6	7.59
VIII.	17.1	3.4	30.6	9.10
XVI.	17.3	1.8	23.5	5.65
IX.	17.6	2.9	29.8	7.08
XI.	18.0	3.6	27.9	7.45
XIV.	18.3	2.2	27.4	6.45
VI.	19.1	3.4	26.0	5.87
IV.	19.4	4.9	33.9	11.20
I.	20.1	3.0	33.6	8.28
XII.	20.4	2.8	29.4	7.93
V.	20.8	4.2	43.8	17.34
III.	24.0	4.2	33.9	10.01
XV.	25.7	3.5	41.9	7.95
XIII.	27.8	3.6	38.7	7.30
II.	28.0	4.0	46.9	11.66
VII.	28.4	5.2	48.0	10.44

Here the death-rates range from 16.7 to 28.4 per 1,000 living. The first six wards which head the list show mean death-rates by all diseases and by phthisis equalling respectively 17.5 and 2.85 per 1,000 living. Their percentage of foreign inhabitants is 27.1. The corresponding death-rates of the last six wards are 25.7 and 4.11. Their population comprise 42.2 per cent. of foreign inhabitants.

It will be noticed that Ward 7 stands quite at the bottom of both tables, showing at once the highest death-rates and the largest proportion of foreign inhabitants. It has been repeatedly shown, in the registration reports of the city, that this ward is one of the most unhealthy, contributing to mor-

tality by all diseases, as well as by specified diseases, out of all proportion to its population. In 1865 Ward 7 contained a population which amounted to only 7.4 per cent. of the aggregate population of the city, and which, nevertheless, contributed 8.27 per cent. of the total mortality, and 11.6 per cent. of all deaths by consumption. In 1870 Ward 7, containing 11.5 per cent. of our total population, supplied 13.4 per cent. of the total mortality, and 17.18 per cent. of all the deaths by consumption. Judging by the census of 1875, Ward 7 contained, in 1874, about 9 per cent. of our total population; in that year, however, this ward contributed 13.25 per cent. of all the deaths by all causes, 15.6 per cent. of all deaths by the eight principal "zymotic" diseases, and 16.7 per cent. of all deaths by diarrhœal diseases.[1] Certain other wards offer similar characteristics, and vie with Ward 7 in unhealthiness, showing occasionally even higher annual rates of mortality.

The foregoing considerations seem to demonstrate the fact that other methods of investigation and other data than those which have been available in the preparation of this report are necessary, if we wish to determine the causes of local variations of mortality in our community. An inquiry based solely upon the evidence contained in our vital statistics certainly appears to be insufficient for the solution of the complex problems involved in this question. By no easier method is it possible to ascertain the local causes of local insanitary condition, and so to acquire information which may serve to direct the efforts of our sanitary authorities, than by direct *local inspection*, organized and carried on by competent health officers and physicians, trained to their task. Examples of what may be accomplished by means of such direct and elaborate inspection of localities which are suffer-

[1] In all these instances, deaths occurring in public institutions are omitted from the calculations.

ing from outbreaks of infective disease, with the result of detecting and suppressing unsuspected nuisances and lurking sources of infection, are to be found in the admirable yearly reports of the medical officer of the Privy Council and Local Government Board of England. As was stated, however, in the first pages of this report, the Commission of the Board of Health have been obliged to fix certain limits to their investigations, and such local researches as have just been alluded to have not appeared to come within the scope of their undertaking. Indeed, it can safely be asserted that no organization whose existence is merely temporary, as is the case with the present commission, could suffice for the exigencies of such a task. The inspection of local causes of undue and preventable mortality must be continuous in its operations, and constantly prepared for every such emergency as is afforded by local outbreaks of infective disease.

CHAPTER IV.

What Measures are recommended?

In framing the following suggestions, which are the final outcome of the present investigation of the sanitary condition of Boston, we do not propose to limit ourselves to advising such measures only as may come within the jurisdiction of the Board of Health of the city. Whatever measures may appear likely to conduce, directly or indirectly, to the sanitary welfare of the community, we shall recommend, without inquiring where the responsibility of their execution may lie.

The suggestions which we have to offer have reference, 1st. To registration. 2d. To sanitation.

1st. · With regard to *registration*, we are of opinion that the mortuary records of this city might in several ways be rendered more serviceable to our sanitary interests than they have been heretofore.

The complex processes of registration begin with the physician, whose office it is to report the "cause of death," using for that purpose designations belonging to some generally accepted nomenclature,[1] and specifying, in strictly *nosological* terms, the fatal disease or injury. Our yearly records, however, show that habits of carelessness and inaccuracy in the discharge of this duty are very generally prevalent among physicians; the cause of these shortcomings being partly insufficiency of diagnosis, due either to the difficulties inherent in obscure cases, or to imperfect medical training, and partly lack of conscientiousness in the performance of registration, whose objects and importance are not appreciated. Of course obscure cases will occur in the practice of every physician; for these due allowance must be made. We are also aware that, in the present general condition of medical education, scientific accuracy of diagnosis and of language can hardly be expected from the majority of physicians. Finally, the

[1] The nomenclature and classification of diseases drawn up, in 1869, by a committee appointed by the Royal College of Physicians, of London, appears to offer great advantages. It is in such general use throughout English-speaking countries as to facilitate the comparison of vital statistics, which is almost impossible unless similar nomenclatures be used in their preparation. For an exposition of the advantages of the classification which we recommend for adoption, see, in Appendix VI., an extract from a report on the subject by Asst. Surgeon J. J. Woodward, to the Surgeon-General, printed in the 9th U. S. Census, Vol. II., p. 6.

The statistical nosology adopted for Registration in Massachusetts does not differ essentially from that to which we have just alluded, and is also, with slight modifications, identical with that of Dr. Wm. Farr. (See 32d Registration Report of Mass., Appendix, p. clvii.; see also a paper "On the Registration of Mortality in Boston," by Dr. F. W. Draper. Second annual report of the Board of Health of Boston, p. 81.)

Dr. Farr's classification is used in the reports of the Board of Health of New York. (See Third Annual Report, 1873, p. 213.)

purely gratuitous character of the professional service rendered by the physician in making out his certificate of the cause of death must be borne in mind, as being, perhaps, some excuse for the carelessness with which this formality is occasionally fulfilled. But, after all these reservations, there can be no sufficient reason or excuse for the exceedingly frequent use of such unscientific, unprecise, or even meaningless designations as are, through ignorance or carelessness, made to do service in our mortality returns as the "cause of death."*

These shortcomings are undoubtedly preventable in part. For this purpose, the attention of physicians should be emphatically called to the great importance of exact registration, and means should be taken to procure the general adoption of a suitable nomenclature, adapted at once to the interests of vital statistics, and to the present general condi-

* An examination of the table exhibiting the "causes of death" in the latest report of the City Registrar (Report for 1874, Table XIII., page 28) shows that nearly a quarter (24 per cent.) of all the designations used in our mortality returns for 1874 fail to convey any *diagnosis* whatever, in the true sense of the word. In a large proportion of cases, amounting to 7.8 per cent. of the entire number of deaths, the term used to designate the "cause of death" only states the organ which was the seat of fatal disease, without any attempt to specify the nature of the morbid process (*e.g.*, disease of bowels, 10; disease of brain, 255; disease of skin, 3; stomach disease, 10, etc.). In other cases, numbering 940, or 12.5 per cent. of the whole, the term used has reference to some symptom, which figures in place of the fatal disease (*e.g.*, apoplexy, ascites, convulsions, diarrhœa, dropsy, fever, paralysis, etc.). In other cases, again, amounting to 3.6 per cent., terms are either misused, or else they only serve to record instances of erroneous, or, at least, untrustworthy diagnosis (*e.g.*, anæmia, 14; asthma, 14; congestion of brain, 60; chicken-pox, 1; gastritis, 45; hydrocephalus, 151). Still another category of cases are those in which death is ascribed to "debility" (157!), or "teething" (41). In view of these facts, it is rather to be regretted that the cases in which the cause of death is recorded as "unknown" should only amount to 14. In other annual Registration Reports of this city, still more absurd "causes of death" are reported, as "inflammation" and "infantile." Against the use of such terms, the City Registrar very justly protests.

tion of medical science in our community.* By such means, immediate results might be obtained. As regards the future, it may be expected that, with the rapid improvements which are taking place in medical education in this country, more accurate habits of diagnosis will prevail; our vital statistics will thus acquire greater value than they can now possess, however conscientiously physicians may make out their mortality returns.

The mortuary returns of this city, such as they are even, do not appear to be so used as to yield the full measure of their utility. Registration undoubtedly has in view other ends besides the collection of sanitary statistics; nevertheless it may be asserted that the latter constitutes one of its principal objects. The annual reports, in which the facts collected in the course of each twelvemonth in the City Registrar's office are summarized and tabulated with a view to bringing out their chief points of interest, and by means of which our mortuary records accomplish their mission as indices of our sanitary condition and needs, certainly should be contrived mainly in view of our sanitary interests.

From this stand-point, then, we feel constrained to say that, in the manner in which the statistical material collected in the City Registrar's office is, each year, prepared and interpreted for the edification and guidance of our sanitary authorities, we recognize the need of the intervention of some person specially qualified, by virtue of a medical education, to deal with sanitary questions. The want of *medical*

* In the preparation of a nomenclature for general use, certain concessions must be made to prevailing shortcomings in the practice of the art of medicine, and scientific accuracy must, in some degree, be sacrificed to expediency. Thus the term *diarrhœa*, although not a nosological designation, must be retained, on account of the obscurity of diagnosis in many cases of infantile bowel disease.

As progress is made in the art of medicine, and as accurate diagnosis becomes more common, greater exactness may be looked for in registration, and a more strictly nosological nomenclature adopted.

supervision and criticism is apparent throughout the Registration Reports which each year serve to convey to the Board of Health such information regarding the sanitary condition of our population as may be extracted from the consideration of the vital statistics of the city; this deficiency is particularly noticeable in the interpretation of the statistical figures and tables, in the inferences which are deduced from their consideration, and in the running commentaries by which they are accompanied. Much could be said, if needful, to substantiate these criticisms. We will only say, however, that the mere fact of the present investigations of the Commission of the Board of Health having appeared necessary is a circumstance which suffices by itself to illustrate the deficiency of the medical element in the City Registrar's department.

It is our belief that vital statistics, which are collected, prepared and published expressly in view of sanitary interests, should invariably undergo the manipulation and the criticism of physicians, and, finally, in the condensed form of registration reports, emanate from medical authority.* In expressing this opinion we no doubt incur the risk of having our views attributed to a feeling of partiality in favor of our own profession; nevertheless, it must be conceded by those who have their own reasons for dissenting from us with regard to the necessity of entrusting the management of sanitary statistics to medical men, that physicians are specially competent to judge of questions relating to sanitation, and are entitled to speak thereon with authority. Therefore our opinion, as expressed above, is not invalidated by the circumstance that it emanates from physicians; but, on the contrary, derives therefrom all its authority.

Besides the defects of quality alluded to above as betray-

* It may be objected that the Registrar-General of England, whose invaluable yearly reports are models of accuracy and completeness, is not a physician. But, in this connection, the long-continued and constant collaboration of Dr. Wm. Farr must not be forgotten.

ing the absence of medical supervision, other deficiencies are apparent in our yearly registration reports. In the extent and variety of the information which they contain, these do not utilize all the data collected in the registrar's office, nor do they seem quite commensurate with the requirements or the ambition of this city. We are of the opinion that if our registration reports could be so enlarged as to render them capable of supplying a greater amount and variety of data relating to our social and sanitary condition, they would become much more useful to those who have charge of the health of the city, as well as more interesting to sanitary statists in general.

Among the principal desiderata are additional tables, which should exhibit much more fully than heretofore the nationality, comprehending both the birthplace and the parentage, of decedents at different ages, and other tables showing the nationality (birthplace and parentage) of decedents by specified diseases. Such tables would supply extremely valuable information which is now unattainable; thus, in connection with our infant mortality, it would be interesting to know the parentage of dying infants; and in connection with certain diseases, such as phthisis, tables giving the parentage of decedents would be very valuable.

We therefore suggest the addition of tables showing: 1st. The ages of decedents by specified diseases. 2d. The nationality, divided according to birthplaces and parentage, of decedents by specified diseases. 3d. The nationality (birthplaces and parentage) of decedents at selected ages. Of course separate tables would have to be constructed to show the birthplaces and the parentage of decedents.

If it should be thought that the preparation of such additional tables would entail too much labor and expense, they might be somewhat curtailed without very great impairment of their usefulness. Thus, tables relating to the birthplaces or the parentage of decedents might only distinguish certain

predominating nationalities. So also with the tables showing the mortality by specified diseases at selected ages or among the various nationalities; the most important diseases, such as phthisis, and the zymotics, might be selected for treatment in this manner.

We would also suggest that advantage be taken of the copious data relating to population supplied every five years by the census. Such additional facts as we have proposed above, if used in conjunction with the returns of the census, would yield extremely valuable results in the shape of special death-rates, distinguishing ages, birthplaces and parentage; especially if the census could be made to comprehend tables showing the parentage as well as the nativities of our population. Our knowledge of the sanitary condition of the city would be still more minute, if part of such data relating to the living and the dying in Boston could be divided according to wards.

The adoption of the foregoing suggestions, in whole or in part, would necessitate a considerable amplification of our yearly registration reports, and a systematic scheme of tabulation would have to be devised which should comprehend all the subjects of inquiry deemed advisable, and exhibit the data in the clearest light. A series of properly constructed tables, once adopted, could be used each year, and the process of filling in the figures of each year, and of deducing appropriate rates, ratios, percentages, etc., would become a matter of tolerably easy routine. To devise a suitable plan for such a report as we have in view is, however, a task requiring considerable thought and judgment.

2. With regard to *sanitation*. We have seen that a considerable proportion of our yearly mortality is due to preventable diseases, which comprise, (*a*) eruptive fevers, (*b*) filth-diseases, (*c*) consumption. The morbific influences by which all these various diseases originate or are transmitted, are

similar to those which occasion the great mortality prevailing among infants.

(*a*) The *eruptive fevers* which call for measures of sanitation are scarlet fever and small-pox.

Scarlet fever is far the more destructive to life of these two eruptive fevers; yet this disease continues to prevail year after year almost uninterruptedly, without any attempt being made to stop its ravages. This seems strange at first sight, when we reflect with what comparative readiness measures of prevention are devised and carried out to limit the extension of small-pox.

The only measures against scarlet fever which are indicated by our knowledge of its causation are, as we have seen, the isolation of the sick, the destruction or the disinfection of all vehicles of mediate infection, and, lastly, such measures of purification as are directed against "filth-diseases" in general.

Theoretically the isolation of diseased individuals, combined with the disinfection of all vehicles of the virus, would, if suitably enforced, check the spread of scarlet fever, and put a stop to the mortality so caused. But the prevalence of this disease, which almost every individual sooner or later contracts, is so very great as to render these measures either absolutely impracticable, because impossible to enforce, or unbearably vexatious. With small-pox the case is very different; as this disease is infinitely less common, the isolation of diseased individuals is much more easily enforced.

Our hope to diminish the mortality occasioned by scarlet fever probably lies in another direction. If we can hardly expect to be able to put an end to the endemic character of the disease, by preventing the transmission of the virus from individual to individual, we have good reason to believe that scarlet fever may assume a much less fatal type, when we shall have succeeded in purifying our city of

the "filth" which prevails in certain districts, and occasions so much preventable mortality.

Against *small-pox*, on the other hand, the available means of prevention, comprising vaccination, revaccination and isolation, are so efficacious, when fully carried out, that the disease might no doubt be completely driven from our community; the records of the first quarter of the century undeniably show this to be the case. (See table on page 84.) We have seen, however, that although isolation is now sufficiently enforced, with results which appear very encouraging, vaccination, on the other hand, is not practised early enough in life to yield its full measure of protection, nor is revaccination sufficiently resorted to at ages when the effects of the first vaccination are passing away. (See pages 93 and 94.)

But although the period of two years, which is now allowed for vaccination, is undoubtedly too long, and although no medical reasons exist for postponing its performance beyond the first weeks, or even the first days, of an infant's life, such very early vaccination being, as a rule, the wisest course, nevertheless, the expediency of further limiting the period allowed for *compulsory* vaccination is doubtful. There is a danger in too zealously enforcing early vaccination, which must be carefully guarded against, however desirable its earliest performance may appear from the standpoint of the physician; a danger, namely, of rendering intolerably vexatious a sanitary measure, the enforcement of which is now quietly submitted to in our community, and of exciting among the ignorant classes an opposition which would perhaps, in the end, defeat the very object of the would-be promoters of so desirable a reform.

This being said, by way of caution, and to show that we are not unmindful of the difficulties which lie in the way of compulsory early vaccination, we would suggest that the period during which children shall be allowed to remain un-

vaccinated be abridged, as soon as possible, to the greatest extent that may appear to be compatible with the general acquiescence of the community. It is to be hoped that public opinion may before long be educated to such a point in this particular matter that it may become possible, at the first outbreak of a new epidemic, to enforce vaccination within the first six months of infancy.

Revaccination is a most valuable means of protection, whose importance needs to be better appreciated in our community than it now appears to be. Compulsion, however, is here evidently out of the question.

(*b*) The "*filth-diseases*" occasion each year the greater part of our preventable mortality. The diseases whose origin or transmission are manifestly dependent upon infection by filth are typhoid fever, and certain forms of diarrhœal disease, the chief of these being cholera infantum. Certain other classes of diseases appear to owe, in some measure, their fatal type, and their wide-spread prevalence, if not occasionally their origin, to filth; we allude to scarlet fever, diphtheria,* and perhaps cerebro-spinal meningitis, as well as certain exceptional forms of pneumonia. In the case of all these diseases a partial dependence upon filth-infection has been suspected, if not actually demonstrated. Moreover, it appears to be not unlikely that many other forms of fatal disease, whose origin and whose processes show absolutely no causal dependence upon filth, may, nevertheless, find easier victims in those sufferers whose general health has been previously undermined by filth-poisoning, recent or chronic, and may so owe their destructiveness in part to this powerful morbific agency. These considerations indicate that

* See a paper on "Cases of Diphtheria," read before the Boston Society of Medical Observation, Oct. 4, 1875, by Dr. E. N. Whittier, in which a local outbreak of this disease is distinctly traced to filthy sources. (Boston Medical and Surgical Journal, Nov. 11, 1875.)

the sum total of deaths attributable, directly or indirectly, to filth, is much greater than the yearly mortality occasioned by the manifest filth-diseases would make us suppose, and we are led to conclude that *the prevention of filth-infection in its various forms constitutes without any doubt the greatest and most urgent sanitary need of Boston.*

The attainment of this end imperatively calls for the adoption of energetic measures designed to prevent all possible contamination of our air, water and food, by the putrefying organic matters of all kinds which constitute "filth." Dirt has been defined, by Sydney Smith, as "matter out of place." So the filth of which we speak is but sewage out of place. When confined within its proper channels, and therein constantly undergoing rapid removal, sewage is harmless, and does not deserve the opprobrious epithet which it incurs under opposite conditions, namely, when stagnating without, or even within its channels; then poisonous vapors are generated and given off, which convey filth-infection in all its forms.

By no other means can the purification of our city from filth be encompassed than by the rapid and continuous *removal* from our midst of all refuse matters, such as constitute sewage, comprising solid and liquid excrements, foul household waters, etc., etc. Any reliance upon "disinfectants" as a means of public sanitation would be but a delusion and a snare.*

In few words, then, what is needed is a rapid and continuous translation of our sewage from its initial starting-points, the water-closet or the privy, and the sink, throughout the entire series of intermediate channels, until it reaches the terminal outlets of our public sewers, which should be situated far beyond the confines of the city.

It is easy to show that with such suitable provision

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* See Mr. Simon in Public Health Reports, New Series, No. II., page 25.

for the complete and rapid removal of all sewage, the escape of noxious emanations from the sewers into our streets and dwellings would be rendered impossible. The conditions under which sewer-gases are generated and penetrate into houses are the following: 1st. *Stagnation of sewage*, by which its putrefaction, and the consequent generation of poisonous vapors are favored. 2d. *Absence of sewer ventilation*, by consequence of which circumstance these vapors are confined and pent up, until they acquire a sufficient degree of tension to force the barriers by which we vainly attempt to exclude them from our homes. By the rapid removal of sewage, on the other hand, its putrefaction in our midst is forestalled; the generation of noxious vapors within our drains and sewers is reduced to a minimum or wholly prevented; the ventilation of the sewers is rendered easy and harmless; and finally such air, gases and vapors as may be contained within the sewers, being no longer confined, but finding an easy escape into the open air, are no longer liable to be forced back through the traps of our household drains and soil-pipes.

The foregoing *résumé* of the conditions under which filth-poisoning takes place, and of the means by which it may be prevented, is designed to show that *the proper management of our sewage is not by any means a question of sewers only;* but that it involves the necessity of a suitable provision for the removal of excreta and refuse of all kinds from the very interior of our dwellings, and for their speedy translation through all the intermediate channels (water-closets, privies, sinks, soil-pipes and household drains) which connect our houses with the public sewers. By consequence of the solidarity which connects private household drainage and public sewerage, it becomes necessary that all the various arrangements which have in view the removal of sewage should, from the beginning to the end of their course, consti tute, as far as possible, parts of one common whole, sys-

tematically devised for harmonious co-operation, and placed under one common jurisdiction. It is therefore evident that the question of the future sewerage of Boston is one which should be understood and acted upon in the most comprehensive manner.

Let us add that the interests of the public in the matter of properly organized drainage demand that our sanitary authorities be permanently invested with complete jurisdiction over sewage from its first starting-points within our homes, as well as throughout the entire extent of its ulterior transit; and that they have full powers in all cases to inspect and supervise, when needful, the construction and the operation of the internal drainage arrangements of dwelling-houses.

It does not come within our province nor our competence to prescribe the manner in which the requirements of Boston in the matter of household drainage and public sewerage are to be satisfied. The mechanical difficulties to be met by the engineer in devising suitable means for such a treatment of our sewage as sanitation demands are no doubt great, but not insurmountable, and the whole matter is in the hands of a special commission which offers every guaranty of its ability to devise the best possible plan for the end in view.

With regard to our *water-supply*, we are of the opinion that the present and future preservation of Lake Cochituate, and of all its tributaries, from all possible pollution by sewage or other refuse, is a question of the most vital importance. Such pollution of our water-supply brings us at once into intimate sanitary partnership, as it were, with the communities whose sewage is thus conveyed to us, however great the distance at which they may be situated.

Although we know for certain that filth of this description cannot be absorbed into the system, even in the most minute

doses, with impunity, yet such are the difficulties attending investigations into the causation of infective diseases in large cities, that sewage might undoubtedly continue to be mingled with our water-supply for some time, without any *appreciable* ill-effects being distinctly apparent in our sanitary condition, provided only that the communities supplying the contaminating sewage remained free from epidemics of infectious disease. But in the event of an outbreak of typhoid fever occurring in the neighborhood whence the infected water-supply is derived, the specific infection would, in all likelihood, be at once conveyed to us in our drinking-water, and so be disseminated throughout the entire city with unmistakable consequences, which are appalling to the imagination.

We have reproduced, on page 113, a passage from a recent (1874) paper, in which Prof. W. R. Nichols points out the danger to be apprehended in consequence of the growth of the town of Natick, whose sewage contaminates Pegan Brook, and thus becomes mingled with the waters of Lake Cochituate. Now, this pollution of Pegan Brook constitutes an immediate and constant peril, which can but grow greater every day, and which should be averted at every cost. An "Act to preserve the purity of the water of Lake Cochituate"[1] was passed on the 19th of May, 1875. We are of the opinion that this law should at once be acted upon by the city, to the full extent of the powers conferred by it, for the

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[1] "An Act to Preserve the Purity of the Water of Lake Cochituate.

"Be it enacted, etc., as follows: —

"Section I. It shall be lawful for the Supreme Judicial Court, upon the application of the City of Boston, to grant an injunction against the discharge of any drainage or sewage-matter, or pollution of any kind, into Lake Cochituate or Pegan Brook, or any waters flowing into said lake or brook; *provided* that this shall not be held to destroy the prescriptive right of any person or persons to discharge such matter into said lake or brook."

Approved May 19, 1875.

protection of our water-supply, not only in order to obtain, with as little delay as possible, such benefit as it may have power to afford, but also in order to test the degree of its efficacy for its intended purpose.

Should this act prove insufficient for the entire protection of our water-supply, by consequence of the restrictions which it contains in recognition of prescriptive rights to contaminate the waters of Lake Cochituate or of Pegan Brook, then every effort should be made to procure a new act, better framed in view of the sanitary welfare of the city.

Looking at this matter as physicians only, and from the sole stand-point of our sanitary interests, we cannot but recognize an urgent necessity for the most energetic and unremitting use of all the resources which legislation may be able to afford for our present and future protection.

Our *milk*, also, should be preserved from such contamination by infectious matters as may take place in consequence of its adulteration with water. The existing laws, prohibiting and punishing the sale of adulterated milk, appear to give ample powers for the repression of this fraudulent and pernicious practice. We would, therefore, simply recommend that they be enforced in future.

(*c*) Mortality by *consumption* is largely preventable by measures belonging both to private and public hygiene, as has been sufficiently shown in the preceding chapter. We would now only recall the strikingly beneficial results obtainable by means of improved drainage in localities where the prevalence of phthisis is partly dependent upon humidity. The possibility of diminishing the fatality of this excessively destructive disease by thorough drainage of the land constitutes an additional and powerful argument in favor of providing the city of Boston, including the semi-rural districts recently annexed, with a system of properly constructed sewers.

ABSTRACT.

1. The mean general death-rate of Boston is 24.5 per 1,000 living. This is the mean death-rate of twenty years (1854–73); of ten years (1865–74); of five census years (1850–55 60–65–70).

2. Considering the demonstrated deficiencies of registration, which prior to 1860 caused our yearly death-rates to be understated, and the diminution of our mortality due to the variations of age-distribution occasioned by the war, the general sanitary condition of Boston, judged by her mean decennial or quinquennial death-rates, seems to have remained about the same during the last twenty years or more.

3. Considering the fact that Boston contains a large proportion of foreign inhabitants, of whom the greater number belong to a race known to present exceptionally high death-rates, and that due allowances must be made for this special factor of insanitary condition, the mean death-rate of Boston cannot be considered as excessively high, compared with the mean death-rates of other cities.

4. The recent high death-rates of Boston (1872–1873) are almost wholly attributable to the influence of temporary causes, whose wide-spread activity was by no means limited to Boston, nor even to the State of Massachusetts.

These morbific agencies of temporary and wide-spread activity were, in 1872, 1st. Epidemics of small-pox, scarlet

fever and cerebro-spinal meningitis, which together killed 3.98 persons per 1,000 living; the mean death-rate by these diseases during the preceding seven years having been only 1.24 per 1,000. 2d. The unusual heat of the month of July, owing to which the diarrhœal death-rate for 1872 was as high as 4.1 per 1,000; the mean rate during the preceding seven years having been 2.83 per 1,000.

The temporary causes of mortality in 1873 were chiefly the same three epidemic diseases which had prevailed during the preceding year. In 1873 these three diseases, small-pox, scarlet fever and cerebro-spinal meningitis, together caused 3.59 deaths per 1,000 living, against 1.24, which was the mean death-rate so caused during the seven years 1865-1871.

5. In estimating the sanitary significance of the elevation recently attained by the death-rate of Boston, due allowance must be made for the effect produced upon our mortality by the rise of the birth-rate, which, from 1864 to 1874, has risen from 25.9 to 35.4, at the nearly uniform yearly rate of increase of one per 1,000 living. This recovery of the birth-rate from the depression caused by five years of war, has increased the proportion of infants and young children in our community, and, by consequence of the high rates of mortality prevailing at early ages, has exerted a slight but distinct influence upon our general death-rate.

6. In view of all the foregoing considerations, the recent high death-rates of Boston do not appear to be at all clearly significant of increased local unhealthiness, nor of more defective sanitation than have prevailed in the past.

7. Although the general sanitary condition of Boston, judged by the comparison of her mean death-rate with that of other cities, and *all conditions being equalized*, appears to be tolerably fair, it must nevertheless be admitted that in

Boston, as in all great cities, a large proportion of undue mortality constantly takes place, amounting each year to 4 or 5 deaths per 1,000 living.

8. It can be shown that these undue deaths, amounting to nearly one-fifth of all the deaths which take place, are owing to removable causes, and that they are in great part clearly preventable by sanitary measures.

9. The examination of our death-rates at different ages, and their comparison with analogous death-rates prevailing in other localities, show that at ages above five years our rates of mortality are quite low; that at ages under five years they are high; and that *among infants under one year of age excessively high rates of mortality prevail.*

Therefore our undue and preventable mortality occurs mainly among infants and young children.

10. Of the aggregate population of Boston, nearly two-thirds (58.4 per cent.) are composed of foreigners and their offspring born in this country. Of the total foreign-born population of the city over two-thirds (64.6 per cent.) consist of Irish. Boston contains the largest proportion of Irish inhabitants of all the great cities of the United States.

11. The general mortality of the foreign element is much greater than that of the native element of our population. This is found to be the case throughout the United States, as well as in Boston.

12. Of the various foreign races domiciled in this country the Irish exhibit the greatest general mortality. Certain diseases are particularly rife among them, namely, Bright's disease of the kidneys, bronchitis, consumption, pneumonia, cancer, and diarrhœal disease; to the first three of these diseases they are liable in a very excessive degree, as compared with the other foreign nationalities.

13. The diseases to which our Irish inhabitants are particularly liable present the following characteristics: —

a. They comprise those affections which, in our community, are at all times the most destructive to life, namely, consumption, bronchitis, pneumonia, and the diarrhœas.

b. They include constitutional diseases, which are transmissible by inheritance, such as consumption and cancer.

c. They include affections which are strongly significant of defective sanitation, and of a widely spread prevalence of habits destructive to health, namely, various "filth diseases," cholera infantum, Bright's disease of the kidneys.

14. Our Irish inhabitants and their offspring, by consequence of their numbers, and of their morbid tendencies, exert a distinct influence upon our apparent sanitary condition. In the case of Boston, the influence thus exerted is so great that it becomes necessary to make allowances for this etiological factor, when attempting to make an estimate of our real sanitary condition compared with that of other cities.

15. The diseases which occasion our undue and preventable deaths, including infant mortality, are the following: —

a. Certain *infective diseases*, commonly called "Zymotics," which together occasion each year over a quarter of all the deaths in Boston. These diseases are disseminated either by *contagion* or by *filth-infection*.

b. *Consumption*, which causes over a sixth of all deaths in Boston. This disease, as well as other forms of tuberculosis, is especially prevalent among our Irish inhabitants. It owes its origin in a considerable proportion of cases to dampness of soil.

16. As regards *prevention*, the spread of the *contagious diseases* can be checked by measures designed to prevent the

dissemination of the infective matters from diseased to healthy individuals, the chief of such measures being the isolation of the sick. Diseases dependent upon *filth-infection* can be prevented by various measures tending to purify the city of its filth. *Consumption* is amenable to prevention by means of drainage of the soil of localities in which it prevails.

17. Our excessive *infant mortality* is chiefly due to summer diarrhœal disease, occasioned by impure air and improper food. As regards public sanitation, the chief remedy lies in measures designed to counteract the effects produced by density of population, and the inadequate removal of refuse matters. The ventilation of crowded streets and dwellings, and the proper management of our sewage, both within and without our dwelling-houses, constitute the means by which the existing impurity of the air may be remedied.

18. All the testimony afforded by our sanitary statistics tends to demonstrate that no measure of public sanitation is more urgently and imperatively necessary than the construction of sewers adapted to the requirements of the city.

(Signed),

CHARLES E. BUCKINGHAM,
CALVIN ELLIS,
RICHARD M. HODGES,
SAMUEL A. GREEN,
THOMAS B. CURTIS.

APPENDIX.

APPENDIX.

I.

INFLUENCE OF VARIATIONS OF THE BIRTH-RATE UPON THE DEATH-RATE.

The war between the Northern and Southern States caused a great diminution of the proportion of adult males living in 1865. In Boston, in 1860, males between the ages of 20 and 50 were 23.7 per cent. of the total population; in 1865, their percentage was 21.2; showing a diminution of 2.5 per cent. (See Mass. Census, 1865, p. 281.)

This loss of adult males of the reproducing ages was a chief cause of the collateral falling off of the birth-rate, which attained its lowest point (25.9) in 1864, the mean birth-rate from 1862 to 1865 (4 years) being 27.5; whereas from 1849 to 1858 the mean birth-rate was 35.98 by the city registration, which was admitted to be very incomplete up to the year 1860. (See City Registrar's Report for 1859, p. 20.)

The continued low birth-rates diminished the proportion of infants and children, so that, in 1865, children under five constituted only 10.3 per cent. of the total population; whereas, in 1855 and in 1860, their percentage was 12.5 (see Mass. Census, 1855 and 1860); their diminution thus amounts to 2.2 per cent. on the aggregate population.

If we apply these data so as to reconstitute the population of 1865 upon its normal basis, as regards age-distribution, we find that, by adding 2.2 per cent. of children, whose death-rate in 1865 we know to have been 92.9 per 1,000, we *raise* the general death-rate (23.62) to 25.08, the addition being 1.46; on the other hand, by adding 2.5 per cent. of adults whose death-rate was 15.1, we *lower* the general death-rate to 24.82, the diminution being 0.26.

The resulting *hypothetical* general death-rate for 1865, obtained after the foregoing correction of the anomalous age-distribution induced by the war, is 24.82, showing that the diminution of the *real* death-rate amounts to 1.20.

Thus we see that the diminution of the percentage of children is associated with, and depends upon, a collateral diminution of the percentage of adult males; these two factors exert contrary influences upon the general death-rate, so that the effect of each is to a certain extent annulled by the other, but the mortality among children (92.9) is so much greater than that of adults between 20 and 50 (15.1) as to make the compensation only partial.

These calculations are corroborated by the result obtained from a comparison of the "normal death-rates" of 1855 and 1865, deduced by applying to the living at different ages the death-rates of the United States life table. The normal death-rate for 1855 is 20.12, while that for 1865 is 19.7. The difference amounts to 1.5, which is approximatively the same result as that obtained above.

II.

THE "NORMAL" DEATH-RATE, HOW OBTAINED.

Ages.	Population by State Census of 1855.	Death-rates by U. S. Life Table.	Deaths at Life-Table rates.
0–5	20,193	62.6	1264.0818
5–10	15,578	9.27	144.0806
10–15	14,090	5.66	79.5494
15–20	15,307	8.50	130.1095
20–30	39,557	11.96	473.0917
30–40	26,956	13.42	361.8703
40–50	15,445	16.95	261.7727
50–60	7,575	25.00	189.2750
60–70	3,695	42.69	157.7395
70–80	1,325	80.65	106.8612
80–90	310	165.79	51.3949
90–	33	327.86	10.8193
Not stated	417	21.6	9.0072
All ages	160,490	.....	3239.5531

Total population = 160,490.

Total deaths, at life-table rates, = 3239.5531.

$$\text{Normal death-rate} = \frac{3239.5531 \times 1{,}000}{160{,}490} = 20.12.$$

III.

HIGH RATES AND PERCENTAGES OF INFANT MORTALITY.

In ten town-districts of England the mean death-rate under five, during ten years (1851–60), was between 100 and 132 per 1,000 living at that age; the highest rates being that of Manchester (117.25), and that of Liverpool (131.98). (Supplement to the 25th Report of the Reg. Gen., Table X., p. xiv.)

In Paris (1862–1866) the death-rate under one was 290 per 1,000. (Bertillon. Démographie figurée, p. 3.)

In France the death-rates per 1,000 under one, during ten years (1857–1866), in eight departements, were as follows: Marne, 277; Ardéche, 283; Oise, 284; Yonne, 289; Seine et Marne, 294; Eure, 308; Seine Inférieure, 313; Eure et Loire 269. (Bertillon. Chart I.)

In Berlin, during a period of fifteen years (1854–1868), over a third of all deaths took place under one year of age. In 1872 the mortality under one was 310 per 1,000; in 1873 it was 320 per 1,000, the general death-rate being 28.29. In 1872 deaths under one were 39.9 per cent. of all deaths. In 1873 their percentage was 42.0. (Berlin. Klin. Wochenshrift, No. 50, 1872; also Monatsblatt, f. Med. Statistik, Sept. and Oct., 1874.)

In New York, during seven years (1866–72), the mean percentage of deaths under one was 30.5; that of deaths under five was 50.0.

In Cincinnati, during seven years (1867–1873), deaths under one were 25.5 per cent. of all deaths; deaths under five were 48.1 per cent. In 1869 deaths under five were 51.0 per cent; yet in the report of the Board of Health of Cincinnati for that year it is said that the mortality of infants under one was only 131.26 per 1,000.

In Cleveland, in 1873, still-births deducted, the percentage of deaths under one was 29.5; that of deaths under five was 49.1 per cent.; yet the general death-rate for that year, as published, is only 19.2 per 1,000.

IV.

Gen. Walker first shows that while, before comparing the native population with the foreign population, the correction heretofore noted, as required on account of the deficiency of foreign children, must be made, the foreign populations may, without any such antecedent correction, be compared together, among themselves, as the deficiency of foreign children may, for the purposes of so large a comparison, be assumed to be uniform.

"Such," he says, "being the readiness and the (comparative) certainty of comparisons between the several constituents of the foreign population, we present in the following table the contributions, in parts of 1,000, made by each specified foreign nationality to the total number of deaths from each enumerated cause, within the total foreign population."

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* For this purpose the form of table used up to the year 1856, and last exhibited in the annual report of the City Registrar for that year, on page 7, appears to us preferable to the form which has subsequently been used.

TABLE.

DISEASES.	Total Foreign.	Irish.	Germans.	English and Welsh.	Swedes, Norwegians and Danes.	Scotch.	French.
All Diseases	1,000	410	282	108	34	27	25
General Diseases—A (febrile)	1,000	282	329	101	78	22	23
General Diseases—B (constitutional)	1,000	454	276	90	24	26	23
Diseases Circulatory System	1,000	431	279	134	18	26	30
Dis. Urinary System and Org. Generation	1,000	442	289	108	22	25	21
Diseases Respiratory System	1,000	408	287	112	29	27	29
Diseases Digestive System	1,000	379	280	121	51	28	27
Diseases Organs of Locomotion	1,000	477	231	108	28	38	33
Diseases Nervous System	1,000	378	292	142	21	36	27
Diseases Integumentary System	1,000	417	236	160	17	27	22
Conditions not necessarily associated with General or Local Diseases	1,000	478	260	101	12	32	27
Accidents and Injuries	1,000	424	251	125	30	23	22
Other and Unknown	1,000	461	243	88	38	23	20
Bright's Disease	1,000	576	213	110	13	28	8
Apoplexy	1,000	381	328	139	9	28	34
Cancers	1,000	412	307	117	11	41	39
Consumption	1,000	478	262	84	25	24	20
Rheumatism	1,000	392	284	103	39	30	36
Paralysis	1,000	409	253	173	11	41	26
Cerebro-Spinal, Enteric and Typhus Fever	1,000	302	332	90	88	20	24
Pleurisy and Hydrothorax	1,000	380	299	99	19	36	43
Bronchitis	1,000	534	228	87	16	25	31
Small-pox	1,000	203	441	36	25	3	24
Pneumonia	1,000	413	284	116	27	29	29
Diarrhœa, Dysentery and Enteritis	1,000	384	271	118	66	30	28
Erysipelas	1,000	358	309	133	29	44	23
Intermittent and Remittent Fevers	1,000	328	335	83	34	18	45
Encephalitis and Meningitis	1,000	332	301	121	38	34	21
Scarlet Fever and Diphtheria	1,000	192	283	189	75	28	7
Measles	1,000	175	240	123	255	39	8
Scrofula	1,000	287	218	113	78	17	26
Hydrocephalus	1,000	277	231	139	15	23	31
Croup	1,000	163	366	159	64	25	10
Whooping-Cough	1,000	153	254	161	178	68	.

"The following appear to be among the most noteworthy features of this table: —

"*Among the Irish*, a comparative exemption from all the general diseases of the febrile group, and from diseases of the digestive and nervous systems; and, on the other hand, a marked liability to general diseases of the constitutional group, including consumption, but with exception of rheumatism, scrofula, and cancers, and to diseases of the organs of locomotion, and of the urinary system, with extraordinary mortality from Bright's disease of the kidneys.

"*Among the Germans*, a reduced mortality from general diseases of the constitutional group, and a decided liability to those, especially small-pox, of the febrile group (being an exact reversal of the relations of the Irish thereto); a comparative immunity from diseases of the organs of locomotion, and of the integumentary system, and, otherwise, a general evenness in the distribution of the body of deaths among the several groups of diseases, and through the list of specific diseases.

"*Among the English and Welsh*, a liability to the diseases of the nervous, circulatory, digestive, and integumentary systems contrasted with comparative immunity from general diseases, both of the febrile and the constitutional groups; of the specific diseases, scarlet fever, diphtheria, whooping-cough, hydrocephalus, croup, erysipelas, apoplexy and paralysis, being relatively most fatal; and consumption, intermittent and remittent, cerebro-spinal, enteric, and typhus fevers, bronchitis, and small-pox, least fatal.

"*Among the Swedes, Norwegians and Danes*, a marked liability to diseases of the digestive system, especially dysentery, diarrhœa and enteritis, and an extraordinary mortality from general diseases of the febrile group, notably, measles, scarlet fever, diphtheria, and typhus, enteric and cerebro-spinal fevers, with comparative immunity from general diseases of the constitutional group, and from diseases of the circulatory, nervous, urinary and integumentary systems, and of the organs of locomotion; the deaths from cancers, apoplexy, paralysis, bronchitis, hydrocephalus, and Bright's disease of the kidneys, being remarkably small.

"*Among the Scotch*, an evenness in the distribution of the body of deaths among the several groups, with marked exception only of the diseases of the nervous system, and of the organs of locomo-

tion, the most noticeable exemptions among the specific diseases being small-pox, scrofula, and the fevers; the most noticeable instances of liability, cancers, paralysis, erysipelas, measles and whooping-cough.

"*Among the French*, a general evenness in the distribution of the body of deaths among the several groups of diseases, with somewhat more of irregularity as to the distribution among the specific diseases than among the Scotch."

(From a paper by Gen. Walker, Superintendent of the Ninth U. S. Census, on the Relations of Race and Nationality to Mortality in the United States. American Public Health Association of 1873. New York, 1875, pp. 35, *et seq.*)

Such are the inferences drawn by Gen. Walker from his figures. Now, with all the deference due to such authority, we venture to interpret these figures somewhat differently. It seems to us that the *key* to this table is to be found in the proportions borne by the various nationalities to the aggregate foreign population, and not in the figures heading the table, which show the contribution of each nationality to mortality in general among foreigners. Thus we know that the Irish are exactly one third, 33.3 per cent. of all foreigners in the United States; consequently, whenever the Irish exceed this proportion in their contribution to mortality occurring among foreigners, they exceed by so much their quota of deaths. Now, if all the nationalities specified in the table were equally liable to death, the same figures would express the share of population and of deaths assumed by each. If all were equally liable to consumption, they would contribute equally to population and to deaths by this disease, and the Irish, who number 333 in every 1,000 foreigners, would show 333 decedents among every 1,000 foreigners dying of consumption. But their proportion of deaths by consumption is 478, and the excess of this figure over 333 gives the measure of *their* liability to the disease in question, compared with that of the other foreigners. According to Gen. Walker, the Irish have "a marked liability to general diseases of the constitutional group, including consumption, but with exception of rheumatism, scrofula, and cancers." Now, it seems to us that as the Irish

share of foreign deaths by rheumatism and cancers (respectively 392 and 412) exceeds their share of population (333 per 1,000), these diseases must be included among those to which they are particularly liable. From scrofula they enjoy a certain degree of immunity, their proportion of deaths by this diathesis being only 287.

We think that the following figures, showing the composition of the foreign population of the United States, are indispensable as a complement to Gen. Walker's table, and we hold that whenever any race exceeds in its contribution to deaths by all diseases, or by any disease, its ratio to the aggregate foreign population, the excess so obtained expresses comparative liability to death; the reverse being true when the contribution to deaths falls short of the contribution to population.

Foreign Population of the United States in 1870.

Total Foreigners.	Irish.	Germans.	English and Welsh.	Swedes, Norwegians and Danes.	Scotch.	French.
1,000	333	303	112	43	25	21

Such being in our view the more correct interpretation of the figures contained in the table which we borrow from Gen. Walker, we offer the following as the characteristics of the two predominant foreign nationalities of the United States: —

The Irish, numbering 333 per 1,000 of the foreign population of the United States, contribute 410 per 1,000 foreign decedents. They therefore exceed in mortality the rest of our foreign population.

They show a marked liability to diseases of the "constitutional group" and a comparative exemption from the diseases of the "febrile group," especially the eruptive fevers. Passing in review the list of specified diseases, we find that the Irish exceed their quota (333) of deaths by all the diseases mentioned, with the exception of those reported under the designations, cerebro-spinal, enteric and typhus fevers (302); small-pox (203), scarlet fever

and diphtheria (192), croup (163), measles (175), whooping-cough (153), intermittent and remittent fevers (320), hydrocephalus (277), and scrofula (287).

They exhibit an extraordinary liability to Bright's disease and to bronchitis; and a very marked liability to consumption, cancer, pneumonia, and diarrhœal diseases.

They enjoy a considerable degree of exemption from all the eruptive fevers.

The Germans, who number 303 per 1,000 living foreigners, only contribute 282 to every 1,000 deaths of foreigners; their mortality is consequently comparatively small. Their morbid predispositions are the reverse of the Irish; they contribute largely and excessively to the diseases of the "febrile group," especially the eruptive fevers; while they show a certain degree of exemption from consumption, bronchitis, pneumonia and diarrhœal diseases, falling short of their quota of deaths (303) by each of these classes of diseases.

They show a very remarkable liability to small-pox (441), and a very slight liability to Bright's disease and bronchitis.

V.

"With regard to the classification of diseases, it was recommended, with your approval, that the tabular form adopted should conform in all essential particulars with the nomenclature and classification published by the Royal College of Physicians of London in 1869.

"It was, of course, fully considered that no classification, based essentially upon pathological views, or upon professional ideas, would be likely to prove acceptable to the majority of medical men; for, in the present condition of medical science, insurmountable differences of opinion still exist as to many unsettled points which must necessarily be involved in the construction of any classification based upon a consideration of the actual nature of disease.

"Under these circumstances it would probably have seemed best to have avoided all classifications, and to have arranged the several diseases and injuries alphabetically on the tabular forms, but for the facility of comparing the mortality tables of the present census with other valuable civil and military mortuary statistics, which could be secured only by adopting the London classification; for this classification is now in use by the Registrar General of England, who employs it in his invaluable annual reports, which, being based upon the actual registration of each death at the time of its occurrence, furnish by far the largest and most valuable mass of mortuary statistics in existence. It has also been adopted in the able and trustworthy annual reports of the medical department of the British army. Moreover, it agrees so nearly in its general outlines with the well-known classification of Dr. Farr, so long employed by statisticians both in England and in this country, as to render it very easy to compare statistical tables, prepared in accordance with either plan, with those prepared in accordance with the others.

"If it could be shown that the classification of the English college was based essentially upon false and injurious pathological notions, which would be countenanced to some extent by its adoption, the objection would have very great weight, in spite of the very great convenience resulting from the adoption of a plan so

favorable to the comparison of results obtained under so many different conditions of time and place; but, in point of fact, the new classification of the college is to a great extent an arbitrary one; motives of convenience rather than pathological dogmas guided its construction. It can, therefore, consistently be used for convenience' sake by all, and without serious offence to the individual opinions of any.

"The same advantages belonged to the classification of Dr. Farr to a greater extent than has been generally acknowledged. But such designations as *Zymotici*, *Miasmatici*, *Dietici*, *Diathetici*, prefixed to some of his classes and orders, were found to give offence in many quarters, and undoubtedly stood in the way of the general adoption of his plan. Stripped of these objectionable titles, with some consolidations and some minor changes, however, the plan of Dr. Farr has ripened into the present classification of the college." *

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* See Report of Assist. Surgeon J. J. Woodward to the Surgeon General of the Army. Ninth census of the U. S., 1870, vol. II., p. vi.

ERRATA.

On page 33 the percentage of Irish inhabitants in Philadelphia is stated as 11.37; it should be 14.3.

On page 80, in the table, the percentage of deaths by diarrhœal diseases is stated as 12.11; it should be 12.5.

On page 172, for "Sydney Smith," read "Lord Palmerston."

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